SHIPPING, ENGINEERING AND MACHINERY EXHIBITION AT OLYMPIA.

The Engineer.

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VOL. CLII.—No. 3948] LONDON: FRIDAY EVENING, SEPTEMBER 11, 1931 [PRICE {WITH SUPPLEMENTS} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

Chelsea Polytechnic,
MANRESA ROAD, CHELSEA, S.W. 3.

SPECIAL COURSES IN ENGINEERING METALLURGY

In addition to the Courses in General Metallurgy, arrangements have been made for Special Courses of Lectures and Practical Work:—

(A) Engineering Metallurgy. Syllabus arranged to cover the syllabus of the Institution of Mechanical Engineers' Associateship Examination in Metallurgy.

(B) Heat Treatment of Metals.

(C) Testing and Mechanical Working of Metals.

(D) Industrial Metallurgy.

The above classes are suitable for Engineers, Consultants, Engineering Students, Works Metallurgists.

COURSES BEGIN
21st SEPTEMBER, 1931.

Full details on application.

Tel., Flaxman 5747. 7493

Northampton Polytechnic INSTITUTE,
St. John-street, London, E.C. 1.
EVENING CLASSES.
in
ENGINEERING.
All branches of Civil, Mechanical, Electrical, Aeronautical, Automobile and Radio Engineering.
APPLIED OPTICS.
Ophthalmic Optics, Optical Instrument Making, Optical Glass Working.
HOROLOGY.
FURRIERY.
APPLIED CHEMISTRY.
Fuels, Electro-plating, Metallurgy, &c.
DOMESTIC AND ALLIED SUBJECTS.
Classes COMMENCE on 21st SEPTEMBER. Enrolments during the week commencing 14th September.
Free prospectus on application to:—
S. C. LAWS, M.A., M.Sc.,
7432 Principal.

Robert Gordon's Technical COLLEGE, ABERDEEN.
(CENTRAL INSTITUTION.)

The Court of the University of Aberdeen and the Governors of Robert Gordon's Colleges co-operate in the PROVISION OF COURSES, leading to the Pass and Honours Degrees of B.Sc. (Engineering) of the University and to the Associateship of the Colleges in the Departments of—

CIVIL ENGINEERING.
MECHANICAL ENGINEERING.
ELECTRICAL ENGINEERING.

FULL-TIME DAY COURSES in MECHANICAL and ELECTRICAL ENGINEERING lead to the Higher National Diplomas in these subjects.

Prospectuses forwarded gratis on application to the SECRETARY and REGISTRAR, Robert Gordon's Colleges, Aberdeen. 7367

University of Manchester.

PHYSICS DEPARTMENT.

Full particulars of the Lectures and Laboratory Courses in Physics, preparing for both the Ordinary and Honours Degrees, will be forwarded on application to the REGISTRAR.

The SESSION COMMENCES on THURSDAY, OCTOBER 8th. 7398

Hull Education Committee.

MUNICIPAL TECHNICAL COLLEGE.

AMENDED ADVERTISEMENT.

HEAD of ENGINEERING DEPARTMENT REQUIRED. Candidates should possess a Degree in Engineering and have had works training and teaching experience.

Salary £600 per annum, rising to £700 by £20 per annum.

Consultative work may be undertaken with the approval of the City Council.

Forms of application and further particulars may be obtained from the undersigned on receipt of a stamped addressed foolscap envelope and must be returned so as to reach these offices not later than Saturday, the 26th September.

R. C. MOORE,
Director of Education.

Education Offices, Guildhall, Hull,
7th September, 1931. 7489

PATENTS AND DESIGNS ACTS, 1907 TO 1928.

Notice is Hereby Given that WALTER KIDDE and COMPANY, INC., of 140, Cedar-street, New York, United States of America, SEEKS LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 311,738, granted to them for an invention entitled "Improvements relating to the Release of Fluid Under Pressure from Containers."

Particulars of the proposed Amendment were set forth in No. 2224 of the Illustrated Official Journal (Patents), published on September 2nd, 1931.

Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of publication of the said Journal.

W. S. JARRATT,
7491 Comptroller-General.

The Engineer

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PUBLIC NOTICES.

ADMINISTRATIVE COUNTY OF LONDON.

School of Engineering and Navigation.

HIGH STREET, POPLAR, E. 14.

MECHANICAL ENGINEERING DEPARTMENT.

Major courses in mechanical, marine and civil engineering, and minor courses in mechanical engineering will commence on

MONDAY, 28TH SEPTEMBER, 1931.

(ENROLMENT during week commencing 21st September, 1931.)

The major courses are "recognised" for the National Certificates in mechanical engineering, both senior and advanced.

Courses are provided for the examinations for A.M.I. Mech. E. and A.M.I.C.E., and for those wishing to join the Royal Navy and Royal Air Force.

Special courses are also provided on Combustion Engineering, Smoke Abatement, Engineering Economics and Refrigeration.

Prospectus and full particulars can be obtained from the Secretary at the School.

MONTAGU H. COX,
Clerk of the London County Council.
7492

PUBLIC NOTICES.

Borough of Bangor (County DOWN).
EXTENSION OF THE OLD PIER, BANGOR HARBOUR.

The Council of the Borough of Bangor are prepared to receive TENDERS for the EXTENSION of the OLD PIER. The work consists of the Removal of the existing Timber Pier Head and the Construction of about 100ft. of Concrete Pier and other work in connection with same, all in accordance with plans and specification prepared by the Consulting Engineer, Sir Cyril Kirkpatrick, M. Inst. C.E., 25, Victoria-street, Westminster, London, S.W. 1.

Copies of the instructions to persons tendering, deed of contract, general conditions, specification, bill of quantities and form of Tender may be obtained from the offices of the Consulting Engineer upon payment of £5 (by cheque only), which will be returned upon receipt of a bona fide Tender.

Drawings may be seen at the office of the Consulting Engineer or at the office of the Borough Surveyor, Town Hall, Bangor, Co. Down.

The carrying out of the works will be subject to conditions with regard to recruitment of labour and the use of British materials laid down by the Government of Northern Ireland and by the Borough Council.

Sealed Tenders, endorsed "Bangor Harbour," addressed to the undersigned at his office at Bangor, must be received before Twelve Noon on Wednesday, the 30th day of September, 1931.

The Council does not bind itself to accept the lowest or any Tender.

By Order,
J. MILLIKEN,
Town Clerk.

Town Hall, Bangor, Co. Down,
29th August, 1931 7468

The Madras and Southern MAHRATTA RAILWAY COMPANY, Limited, invite TENDERS for:—
STEEL MATERIAL.

Tenders are due in on Tuesday, 29th September, 1931, by 2 p.m. Tender form obtainable at address below, fee One Guinea, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices:
25, Buckingham Palace-road,
Westminster, S.W. 1. 7508

PUBLIC NOTICES

Borough of Chepping Wycombe
WATERWORKS.
15IN. DIA. STEEL PUMPING MAINS.
CONTRACT NO. 1, STEEL PIPES.

The Corporation of the above Borough invites TENDERS from experienced British Manufacturers for the SUPPLY and DELIVERY at High Wycombe and West Wycombe Railway Stations of about 9400 YARDS of 15in. dia. SOLID-DRAWN WELDLESS STEEL PIPES, coated and wrapped, together with the necessary SPECIAL PIPES and BENDS.

Copies of the specification, bills of quantities and form of Tender may be obtained from the office of Mr. W. Vaux Graham, M. Inst. C.E., 5, Queen Anne's-gate, Westminster, S.W. 1, upon depositing the sum of Five Pounds, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, marked "15in. Dia. Pumping Main, Contract No. 1, Tenders for Steel Pipes," must be received by Mr. Sydney Young, Waterworks Engineer and Manager, 71, Easton-street, High Wycombe, not later than the first post on Monday, September 21st, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

PHILIP B. BEECROFT,
Town Clerk.

Town Clerk's Office,
High Wycombe.
31st August, 1931. 7470

Borough of Chepping Wycombe
WATERWORKS.
NEW SERVICE RESERVOIRS.

The Corporation of the above Borough invites TENDERS from contractors experienced in Ferro-concrete Work for the CONSTRUCTION and MAINTENANCE of TWO COVERED SERVICE RESERVOIRS as follows:—

Low Level (No. 1) at Bowerdean-road, High Wycombe, of a capacity of 2 million gallons; and

High Level (No. 2), at Widdenton Park Wood, Lane End, Bucks, of a capacity of 1 million gallons.

The contract will include the Construction of both Reservoirs in Ferro-concrete (Hennebique System), with Brick Valve Houses and all necessary Valves and Pipe Connections, &c.

Drawings may be seen at the office of Mr. W. Vaux Graham, M. Inst. C.E., 5, Queen Anne's-gate, Westminster, S.W. 1, and copies of the specification, bills of quantities and form of Tender obtained from him upon depositing the sum of Five Pounds, which will be returned upon the receipt of a bona fide Tender.

The works are to be carried out in strict accordance with the conditions laid down for materials and labour by the Unemployment Grants Committee, and the contractor will be required to undertake to commence the works immediately on acceptance of his Tender.

Sealed Tenders, marked "Tender for Service Reservoirs," must be received by Mr. Sydney Young, Waterworks Engineer and Manager, 71, Easton-street, High Wycombe, not later than the first post on Monday, September 28th, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

PHILIP B. BEECROFT,
Town Clerk.

Town Clerk's Office,
High Wycombe.
31st August, 1931. 7469

Borough of Chepping Wycombe
WATERWORKS.
15IN. DIA. PUMPING MAINS.
CONTRACT NO. 2, MAIN LAYING.

The Corporation of the above Borough invites TENDERS from experienced Contractors for the CARTING, LAYING and JOINTING of about 9600 YARDS of 15in. Dia. STEEL PIPES (supplied by the Corporation), together with the PROVISION and FIXING of the necessary SLUICE VALVES, AIR VALVES and HYDRANTS, between the Penn Mill Pumping Station and the Bowerdean-road and Widdenton Park Wood Service Reservoirs, about to be constructed. The contract will also include the LAYING alongside the trench of the 15in. Main a CABLE for Electrical Recorders (supplied by the Corporation).

Drawings may be seen at the office of Mr. W. Vaux Graham, M. Inst. C.E., 5, Queen Anne's-gate, Westminster, S.W. 1, and copies of the specification, bills of quantities and form of Tender obtained from him upon depositing the sum of Five Pounds, which will be returned upon the receipt of a bona fide Tender.

The works are to be carried out in strict accordance with the conditions laid down for materials and labour by the Unemployment Grants Committee, and the contractor will be required to undertake to commence the works immediately on acceptance of his Tender or as soon after as the pipes are available from the manufacturers.

Sealed Tenders, marked "15in. Dia. Pumping Mains, Contract No. 2, Tender for Main Laying," must be received by Mr. Sydney Young, Waterworks Engineer and Manager, 71, Easton-street, High Wycombe, not later than the first post on Monday, September 28th, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

PHILIP B. BEECROFT,
Town Clerk.

Town Clerk's Office,
High Wycombe.
31st August, 1931. 7471

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PUBLIC NOTICES.

County Borough of Wolverhampton.

BARNHURST SEWAGE PURIFICATION WORKS.
CONTRACT NO. 8.

TO MAKERS OF PUMPS AND ELECTRIC MOTORS.

The Corporation is prepared to receive TENDERS for the SUPPLY of FOUR SETS of SLUDGE PUMPS of the Treble-ram or Two-barrel Double-acting Type driven by Electric Motors. Also for ONE CENTRIFUGAL PUMP driven by an Electric Motor for pumping sewage which has received tank treatment.

Each sludge pump will be required to discharge 230 gallons of sludge per minute. The centrifugal pump will be required to discharge about 1000 gallons of sewage per minute.

Tenderers will be required to submit prices for manufacture, delivery and installation of the required plant, piping, switchgear and other details. Two sludge pumps and the sewage pump are to be installed in one pumping station and the other two sludge pumps in a second pumping station.

On and after the 14th September, 1931, general conditions, specifications, schedules, bill of quantities and form of Tender may be obtained from the Engineers, Messrs. Dodd and Watson, MM. Inst. C.E., Wellington House, Bennetts Hill, Birmingham, on payment of a deposit of £2, which will be returned only on receipt of a bona fide Tender and the return of all documents.

A plan showing the constructional details of the pumping stations, a diagram of the connections required, and the pipe line to which the pumps are to be connected will be forwarded with the specification by the Engineers. Two other drawings showing teatative lay-outs of the piping in the two stations may be inspected at the Engineers' offices in Birmingham.

Sealed Tenders, addressed "J. Brock Allon, Esq., Town Clerk, Wolverhampton," and endorsed "Tender for Contract No. 8," should be delivered at this office before Noon on Tuesday, October 13th, 1931.

The Corporation does not bind itself to accept the lowest or any Tender.

J. BROCK ALLON,
Town Clerk.

Town Hall, Wolverhampton. 7498

Metropolitan Water Board.

TENDERS FOR THE MANUFACTURE, DELIVERY AND ERECTION OF SIX VERTICAL HIGH-COMPRESSION HEAVY FUEL OIL ENGINES WITH CENTRIFUGAL PUMPS AND APPURTENANT WORKS AT BRIXTON PUMPING STATION.

The Metropolitan Water Board invite TENDERS for the MANUFACTURE, DELIVERY and ERECTION of SIX VERTICAL HIGH-COMPRESSION HEAVY FUEL OIL ENGINES with CENTRIFUGAL PUMPS and APPURTENANT WORKS at their Brixton Pumping Station, Brixton-hill, London, S.W. 2.

Forms of Tender, conditions of contract, specification and drawing may be inspected without charge at the offices of the Board, Chief Engineer's Department (Room 173), on and after Monday, 14th September, 1931.

Contractors desirous of tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of Two Guineas, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawing. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Vertical Oil Engines, Brixton," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Thursday, 15th October, 1931.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
8th September, 1931. 7505

County Borough of Swansea.

ELECTRICITY DEPARTMENT.
SUBAQUEOUS TUNNELS AND SHAFTS, DOCK INTAKE AND DISCHARGE AND FOUNDATIONS FOR POWER STATION AT TIR JOHN NORTH.
APPOINTMENT OF RESIDENT ENGINEER.

The Council invite APPLICATIONS for the TEMPORARY APPOINTMENT of a RESIDENT ENGINEER.

Salary at the rate of £750 per annum.

The duration of the works will be for a probable period of 2½ years, and the above appointment will be determinable by one month's notice on either side.

Applicants for the appointment must have undergone a regular course of engineering training and be thoroughly experienced in the duties of Resident Engineer, as applied to works of considerable magnitude carried out under contract.

It is essential that applicants shall have had considerable previous experience in subaqueous tunnels and shafts.

Applications must be made on a form to be obtained from the undersigned, to whom applications shall be addressed, endorsed "Resident Engineer" and be received not later than the first post on the 1st October, 1931.

H. L. LANG-COATH,
Town Clerk.

Guildhall, Swansea,
8th September, 1931. 7500

Egyptian Government.

APPOINTMENT OF A MECHANICAL DRAUGHTSMAN.

APPLICATIONS are INVITED for APPOINTMENT as MECHANICAL DRAUGHTSMAN in the Ministry of Public Works, Cairo, for work with the Egyptian Irrigation Service in the Sudan.

Applicants must be of British nationality, between 30 and 35 years of age, preferably unmarried, with the following qualifications:—

Must be a qualified Mechanical Engineer with drawing-office experience in both ship construction and marine engineering.

Must have a thorough knowledge of machine and power station plant.

Salary between £E300 and 420, according to qualifications, plus forty per cent. Sudan allowance (£E1 equals £1 0s. 6d. approximately) free of Egyptian income tax.

Pay begins on day of reporting for duty in Cairo. Sudan allowance begins on arrival in the Sudan.

Free furnished quarters provided when working away from Khartoum.

The appointment is subject to medical examination.

The selected candidate will be granted actual expenses of steamer and railway journey to Egypt plus £E10, provided total does not exceed £E40. Free transport Cairo to Khartoum and similarly on return from Egypt.

Initial period of contract two years, subject to renewal.

Third-class fares and reasonable out-of-pocket expenses will be paid to applicants who are requested to attend for interview and/or medical examination.

Application and specimen contract forms may be obtained from

THE CHIEF INSPECTING ENGINEER,
EGYPTIAN GOVERNMENT,
41, Tothill-street, Westminster,
London, S.W. 1,

to whom they should be returned with full particulars as to education, qualifications, previous experience, personal references, and COPIES of certificates or testimonials.

Envelopes to be inscribed "Mechanical Draughtsman." 7490

To be published on Monday

SEPTEMBER 21

The Times

FARADAY

NUMBER

TO mark the Centenary of one of the greatest of all scientific discoveries The Times will publish this Special Number to which some of the world's most distinguished philosophers, scientists and electrical experts will contribute. Among the many profoundly interesting articles which will appear will be :—

Faraday and the Production of Electricity from Magnetism	Sir William Bragg, O.M., F.R.S.
The Link between Faraday and Maxwell	Sir J. J. Thomson, O.M., F.R.S.
Faraday as an Experimenter	Lord Rutherford, O.M., F.R.S.
Faraday's Conception of the Ether	Sir Oliver Lodge, F.R.S.
The Development of Wireless Telegraphy	The Marchese Marconi
Faraday's Work on Steel	Sir Robert Hadfield, F.R.S.
The Foundations of Electrical Engineering	Sir Ambrose Fleming, F.R.S.
The Electrical Manufacturing Industry as a National Asset	Sir Hugo Hirst

PROFUSELY ILLUSTRATED

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The Times

ORDER YOUR COPY NOW

PUBLIC NOTICES

The Civil Engineers Appointments Board,

8, Princes-street, Westminster, S.W. 1, acting under annual licence from the London County Council, invites INQUIRIES from EMPLOYERS SEEKING the SERVICES of PROFESSIONAL ENGINEERS, either as Assistants or in more responsible positions.

All those whose names are accepted for entry in the Board's Register for employment possess qualifications which have been attested by means of scientific examinations, practical training and experience. P1305

ADVERTISEMENT.

The Municipal Commissioners

of GEORGE TOWN, Penang, REQUIRE a CHARTERED CIVIL ENGINEER ASSISTANT for their Water Department, aged 23 to 36 years and unmarried, the appointment being in the first instance on a three years' agreement, with possible extension on the permanent staff.

Applicants must have had a good technical education and a regular training as pupil and assistant with a County Engineer or a Civil Engineer in private practice, preferably in an office engaged on works of water supply. Candidates must have had at least five years' all-round experience in water supply, and the selected candidate must be prepared to work under the Water Engineer or Deputy Water Engineer on maintenance and/or construction and also on anti-malarial work. Experience in the carrying out of work by direct labour is desirable.

Applicants must be Corporate Members of the Institution of Civil Engineers or have passed the requisite examination.

Salary, 4800 dollars for the first year, 5100 dollars for the second year, and 5400 dollars for the third year of the agreement. The salary will be paid monthly in dollars, the currency of the Colony, the value of the dollar being 2s. 4d. sterling. In addition there is, at present, a temporary allowance of 5 per cent. on the salary for unmarried men. The pay of the appointment at the above rate for the first year, including temporary allowance, would be £588. An allowance for the maintenance of a motor car when on duty will be granted. Free first-class passage will be provided, with half-pay during voyage out and home. The selected candidate must pass an approved medical examination.

Eight months' leave, on full pay, with passage paid is usually granted after four years' service, if the appointment be continued for that period and the officer intends to return to Penang.

There is a generous superannuation and Provident Fund for municipal officers.

George Town is situated on the coast within three miles of the Penang Hill Railway, which runs up to the Hill Station, 2400ft. above sea level.

Applications, stating whether married or single and giving age and birthplace, with full details of education, training and experience generally, and referring particularly to the qualifications mentioned above and accompanied by copies (not originals) of testimonials, to be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 1, Victoria-street, London, S.W. 1, Agents for the Commissioners, not later than Thursday, 24th September. Further particulars, if desired, can be obtained from the Agents. 7487

Metropolitan Water Board.

APPOINTMENT OF TWO TEMPORARY ENGINEERING ASSISTANTS.

The Metropolitan Water Board invite APPLICATIONS from students of the Institution of Civil Engineers, or those who have passed an examination qualifying for studentship, for the APPOINTMENT of TWO TEMPORARY ENGINEERING ASSISTANTS in the Chief Engineer's Department, at an inclusive salary of £3 per week.

Applications, in candidates' own handwriting, stating age and full particulars of training and qualifications, should be addressed to Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, and must reach the offices of the Board not later than the 21st September, 1931.

Canvassing will be held to be a disqualification.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
7th September, 1931. 7497

The North Norfolk Rivers Catchment Board

REQUIRE the SERVICES of a competent MAN to act as CLERK of WORKS on the Construction of a Concrete Culvert at Hescham, to be carried out under contract, and to Superintend the Construction by direct labour of an Earth Embankment across the Hescham River, both under the supervision of the Consulting Engineers, Messrs. Lewis and Lewis, 15, Victoria-street, Westminster, S.W. 1. Estimated duration of work six months. Applications, stating age, experience, qualifications, salary required, and submitting copies of testimonials, to reach me at my office, Fakenham, Norfolk, not later than Monday, September 21st, 1931.

F. ANDREWS,
7504 Clerk to the Board.

SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

WANTED, ASSISTANT WORKS MANAGER for Heavy Road Vehicle Manufacture.—Address, stating age, experience, names of previous employers, and salary required, 7511, The Engineer Office. Applications will be treated confidentially. 7511 A

WANTED, CHIEF DESIGNER for Heavy Road Vehicle Builders, Public Service and Goods; must be well up in Diesel Engine Work.—Address, stating age, experience, names of previous employers, and salary required, 7510, The Engineer Office. Applications will be treated confidentially. 7510 A

WANTED, COMBUSTION ENGINEER, Used to Evaporative Tests, Fuel Sampling and Calorimeters, &c. State age, experience, and salary required. Manchester district.—Address, 7482, The Engineer Office. 7482 A

WANTED, Experienced COAL MINING ENGINEER; wanted for sales of Colliery Equipment. Must be used to all sizes of seams and heavy weights of roof. First-class certificate an advantage. Must have experience of handling men.

Address, stating age, education, give experience and salary last earned, 7502, The Engineer Office. 7502 A

WANTED, YOUNG GENTLEMAN with Knowledge of Machine Tool Business to join established Firm as PARTNER, willing to invest £500.—Address, 7507, The Engineer Office. 7507 A

WANTED, Young SALESMAN DEMONSTRATOR for Portable Air Compressors and Pneumatic Tools, for London district. Previous experience essential. State salary.—Address, 7501, The Engineer Office. 7501 A

ADDITIONAL TUTOR REQUIRED for Engineering subjects. High qualifications essential. Residence in Oxford unnecessary.—OXFORD CORRESPONDENCE COLLEGE, Beaumont House, Oxford. P1478 A

For continuation of Small Advertisements see page 4.

A Seven-Day Journal

The Schneider Trophy.

WHEN the Royal Aero Club received last week official intimation that neither France nor Italy would participate in the race for the Schneider Trophy to-morrow all hope that these countries would be able to get their machines ready in time disappeared. Their preparations have been delayed by bad luck and bad weather. Both countries first asked for a postponement of the race, and when the Royal Aero Club replied stating that the rules did not permit such a postponement, they withdrew, although both nominated pilots, apparently with the object of complying with the strict regulations in case there happened to be no contest. There will, therefore, be no race to-morrow, but the British seaplanes will fly round the course and claim a walk-over. According to the rules, the Trophy becomes the property of the nation that wins the race three times in five consecutive contests. Britain has won the last two. The present arrangement is that one of the new S 6 B machines shall fly at full throttle and attempt to set up a new record for the course, the two other machines entered being kept in reserve. It is stated that the new Rolls-Royce S 6 B seaplanes have reached a speed of about 405 miles per hour. The improvement in the weather during the last few days has allowed a number of practice flights to be made. Excitement was caused last Monday when one of the new machines piloted by Flying Officer Snaith landed after flying only seven minutes. The engine of his machine, he reported, had exceeded the normal number of revolutions per minute; it is to be fitted with a new propeller. Preparations for the contest, it is estimated, have cost this country in the neighbourhood of £150,000.

Coal Seams in the Manchester District.

IN a treatise on the geology of Manchester and the South-East Lancashire coalfield, published by the Geological Survey of Great Britain, some interesting figures regarding unworked coal seams in the district are given. Within the boundaries of the Bradford coalfield it is estimated that there are at least 10,000,000 tons on one side of the Roger Mine, while a further 10,000,000 tons lie in a seam dipping to a depth of 4000ft. The surface of this area is largely built over, but it is considered that little damage is likely to occur by subsidence. On the west side of Prestwich there is also believed to be an area, as yet undeveloped, of considerable value. The authors of the treatise estimate that there are 4,000,000 tons in the Crumbouke Mine and 7,000,000 tons in the Rams Mine at depths no greater than 1000ft. below Ordnance Datum, while the Doe, Trencherbone and Cannel Mines contain 15,000,000 tons at depths of less than 2000ft. Mention is also made of the Black, the Roger, and the Ashton Great Mines, in the district south of Failsworth, and west of Ashton-under-Lyne, which, it is thought, are likely to be developed in the future.

Motor Boat Racing.

THE latest attempt of a motor boat from this country to bring back the Harmsworth International Motor Boat Trophy ended early in the second race of the series. The winning boat must win two out of the three heats. "Miss England II.," which holds the world's record speed of 110 m.p.h., was piloted by Mr. Kaye Don. In the first heat over the course of 30 miles in the Detroit River last Sunday "Miss England II." won by more than a mile at an average speed of 89·913 m.p.h. The course is triangular, and although the boat lost ground at the turns and skidded badly at times her speed was superior on the straight. One lap—the second—was completed at 93·017 m.p.h. In the second race, however, which took place last Monday, "Miss England II." and "Miss America IX.," driven by Commodore Gar Wood, crossed the starting line almost together, the English boat being a little behind. At the first turn "Miss England II." was caught by the wash of the other boat and, skidding at the same time, turned over. Mr. Kay Don and his two mechanics were thrown out and escaped without injury. The boat sank. It was later announced that both the boats had been disqualified, having passed the starting line a few seconds too soon. "Miss America VIII.," another boat entered by Gar Wood, completed the course and won the heat. According to the rules of the contest, disqualification in one heat debars that boat from competing in any further heats, so "Miss England II.," even if she could be raised in time, is eliminated.

Wireless Regulations for Italian Ships.

THE requirements of a new decree regulating the use of wireless apparatus on Italian ships exceed those that were laid down as the result of the Washington and Safety of Life at Sea Conventions. On ships which carry dangerous cargo, for example, the wireless cabin must be constructed of iron and be situated in one of the highest and most isolated parts of the vessel. A fire-extinguisher with the necessary spare parts must be provided in every wireless cabin. Wireless circuits must be separated from the ship's compass by at least 8 m., and all electric conductors on the upper deck must either be enclosed in metal tubing "earthed" to the ship's hull or consist of armoured cable. The pressure of the main wireless supply must not exceed 250 volts. The decree ensures a high aerial efficiency by insisting that the aerial wires be erected at least 3 m. above the tops of the funnels, whilst in the case of ocean-going vessels the height is fixed at not less than 15 m. above the superstructure. A spare aerial accurately tuned to the international distress call, and having a screened lead-in to prevent damage, is to be carried; whilst to obviate loss owing to absorption the rigging is to be divided into sections by porcelain insulators. The main wireless equipment specified by the decree is practically the same as that called for by the British regulations. On certain routes, however, vessels of upwards of 3000 tons are compelled to have a short-wave transmitter, whilst direction-finders are compulsory on all vessels trading outside the Mediterranean area.

The New Cunarder and the Clyde Trusts.

AT a meeting of the Clyde Lighthouses Trust last Wednesday, when negotiations between that Trust and the Greenock Harbour Trust were carried on, a satisfactory settlement was reached with regard to the deepening of the river Clyde, made necessary in order that the new Cunarder may pass down the river. Application was made to the Greenock Trust for permission to deepen the channel. Although some difficulties had to be faced, a mutual agreement was finally reached, and was ready for signature yesterday. It was at first feared that it would be necessary to go forward with a provisional order, which might have been a costly proceeding, but this was fortunately avoided. Engineers have made a survey of the district, but it is understood that a complete survey for the dredging operations will not be conducted until preparations for dredging the channel are well advanced.

Exhibitions and the Motor Industry.

THE desirability or otherwise of continuing annual Motor Exhibitions has been much discussed recently, and the Society of Motor Manufacturers and Traders feels that its position, representing as it does all sections of a great industry, may be of interest. The Motor and Commercial Vehicle Exhibitions have, during more than a quarter of a century, become of more than local or specialised interest, and the Society has of necessity studied every factor in deciding, from time to time, what policy may best meet the requirements of the industry and the wishes of the public. The Council of the Society, which represents every section of the motor trade, manufacturers, importers, and distributors, decides all questions of policy, and, in the light of the many interests involved, questions upon which there must of necessity be differing opinions are ventilated from every point of view, and seldom indeed is any decision of major policy taken without ultimately complete unanimity. The general political situation, as an example, necessitated some consideration of exhibition policy, and the Management Committee of the Society had no hesitation in deciding that it was its duty to the public to proceed with its plans for both the Motor and Commercial Vehicle Exhibitions in October and November respectively. What exhibition policy may be contemplated in the future will be considered in due course, but no reversal of a policy which in the past has undoubtedly proved to the benefit of the community will be made without the fullest possible consideration.

Aerodromes.

IN the first report of the Aerodromes Committee of the Royal Institute of British Architects on Town Planning and Aviation, included in the report of the Ministry of Health, published last Thursday, the statement is made that until there are safe landing fields at intervals of not more than 20 miles Great Britain cannot be considered properly equipped for the flying of the next ten years. It is pointed out that the grass lands of this country would make excellent landing grounds for aircraft at very little cost, and that there is a great need for the provision of such grounds to encourage internal air transport. It is considered that safety requirements and proximity to the centres of towns are likely to be the deciding factors in the choice of the positions of aerodrome sites. The Committee is of the opinion that access to the chosen sites by railway, tramway, or tube services should also be planned as soon as possible. The importance of reserving suitable aerodrome sites, owing to the rapid building developments and the consequent increase in the expense of purchase and compensation with every month that passes, is pointed out; while it is considered that the future aerodromes of the country must be owned by the community through its local government organisations rather than by individuals. Co-operation between local authorities is therefore desirable, particularly for town-planning schemes. Large and complex buildings, it is believed, will be necessary at aerodromes in the future. In this connection it is interesting to note that a number of municipal aerodromes have already been established. Blackpool, Bristol, Ipswich, Hull, Liverpool, Manchester, Nottingham, and Plymouth all have aerodromes, while several other places are making the necessary arrangements.

A New Glasgow Graving Dock.

IN our issue of July 17th last we reported that negotiations had nearly been completed by Barclay, Curle and Co., Ltd., of Glasgow, for the construction of a new graving dock at Elderslie, Scotstoun. We now learn that the contract for the constructional work in connection with the scheme has been placed with Sir Robert MacAlpine and Sons, of Glasgow, and that the work will shortly be put in hand. The new dock will have a length of 620ft., an entrance width of 85ft., and a depth over the sill at high water during ordinary spring tides of 28ft. It is to be placed alongside the existing dry basin known as the Elderslie Dock, and will be equipped with up-to-date electric, pneumatic, and hydraulic services, the area around it being specially arranged for the handling of heavy machinery, for which suitable crane equipment will be installed. At present the firm is able to handle annually for repairs about 750,000 tons of shipping. When the new dock is finished the capacity of the ship-repairing establishment will be in the neighbourhood of 1,000,000 tons annually. We understand that the firm is to concentrate its ship-repairing activities at the Clydeholm Yard, and that the West Shipyard will be dismantled. Adjoining the graving docks a fitting-out wharf is being constructed. The total cost of the new scheme is likely to be about £500,000, and, as we reported in our Journal note of July 17th, it was first considered in 1919, when the proposition was carefully discussed in all its bearings.

The Application of X-Rays to Industrial Research.

THE report of the committee which, under the chairmanship of Sir William Bragg, has been investigating the application of X-rays to industrial problems was issued by the Department of Scientific and Industrial Research last Monday. The work which the committee has been doing since it was established in 1927 has been to a certain extent of an exploratory character, and although it has covered a wide range of subjects, only a small fraction of the field of possible applications has been examined. In many of the investigations it has been the aim, in the first place, to test the possibilities of the method rather than to solve specific problems. Among the earliest of the efforts of the committee was an X-ray examination of permanent magnet steels, especially tungsten steels, with particular regard to the phenomena of the "spoiling" and "recovery" of these steels. The investigations showed that the method indicates more clearly than any other the structural changes which accompany the heat treatment of the steels and that the "spoiling" is due to the presence of, at least, two distinct crystalline constituents. In another investigation X-rays disclosed changes in the crystal structure when a metal was cold rolled or drawn into wire; whilst yet another was carried out in conjunction with the Research Association of British Paint, Colour and Varnish Manufacturers. A survey of materials used in the paint industries was made with a view to ascertaining the possible applications of X-ray analysis in this field. The survey has indicated that the size of the elementary crystals is of great importance in connection with the quality of many paint materials.

New P. and O. Liner Strathnaver.

ON Friday afternoon of last week, September 4th, the new turbo-electrically propelled P. and O. liner "Strathnaver" docked at Tilbury after her voyage from the Clyde, which followed very successful trials on the Skelmorlie measured mile and in the Firth of Clyde. A small party of guests accompanied the ship round, and had the experience of witnessing the behaviour of the ship at various speeds. Many comments were made on her great steadiness and the noteworthy absence of vibration and noise in all parts. As previously recorded in these columns, the "Strathnaver," like her sister the "Strathaird," was built at the Naval Construction Yard of Vickers-Armstrongs, Ltd., Barrow-in-Furness, for the owners' service between London, Bombay and Australia. They have the distinction of being the largest and fastest units in the P. and O. fleet, and are characterised by the graceful lines of the hulls and their three well-proportioned yellow funnels. The hulls are painted all white in contra-distinction to the traditional black hulls and funnels and yellow upper works of the older P. and O. ships. The "Strathnaver" is electrically propelled, the machinery being supplied by the British Thomson-Houston Company, Ltd., of Rugby, and the boilers by Yarrow and Co., Ltd., of Scotstoun, Glasgow. The boilers are especially interesting, as their designed output of about 69,000 lb. each make them the largest yet installed in the British mercantile marine. The trials showed that the vessel was capable of developing a speed of over 23 knots, and that the fuel consumption for all purposes, including the hotel, heating, and ventilating loads, was only 136 tons per day for a normal speed of 20 knots and 70·3 tons per day for a cruising speed of 15½ knots.

The Shipping, Engineering and Machinery Exhibition at Olympia.

No. I.

ABOUT three hundred firms and organisations are represented at the Shipping, Engineering and Machinery Exhibition at Olympia, which was opened on Thursday. In the Supplement which accompanies this issue, we give particulars of a wide variety of the exhibits, but within its limits it has been impossible adequately to cover the ground. In the following pages, therefore, we deal with the products of other firms, and we hope in succeeding issues to continue our account of the wide range of material exhibited at the Show.

BROOM AND WADE, LTD.

One of the most novel exhibits on the stand of Broom and Wade, Ltd., of High Wycombe, is the air compressing set illustrated by Figs. 1 to 3. It is capable of delivering 100 cubic feet of free air per minute at a pressure of 100 lb. per square inch, and is driven by a Lister oil engine.

The compressor is of the sleeve valve type, and has two cylinders, 5in. in diameter by 4¼in. stroke. It runs at 1200 revolutions per minute. The valve sleeve A—see Fig. 2—within which the piston works, has a number of ports E drilled round its circumference for the admission of air. The air inlet port is shown at D, and the excentric which works the sleeve at C. Piston rings are provided at B for making a tight joint between the sleeve and the bore of the cylinder. The delivery takes place through the non-return valve H.

In action when the piston is about half-way up on the compression stroke the top of the sleeve valve opens a port formed by a special type of sealing ring F, and this puts into communication with the cylinder, the completely water-jacketed annular space G. This action serves a double purpose, as it increases the capacity of the cylinder, and thus delays the final compression until the piston is nearer the end of its stroke, and is consequently moving comparatively slowly, while, at the same time, it greatly increases the water-cooled surface in contact with the air. In comparison with the normal type of plate valve compressor this increase is in the ratio of 3·5 to 1, when the piston is within 1in. of the top of its stroke. The result is, of course, that the heat of compression is well absorbed by the water and cool air is delivered by the machine.

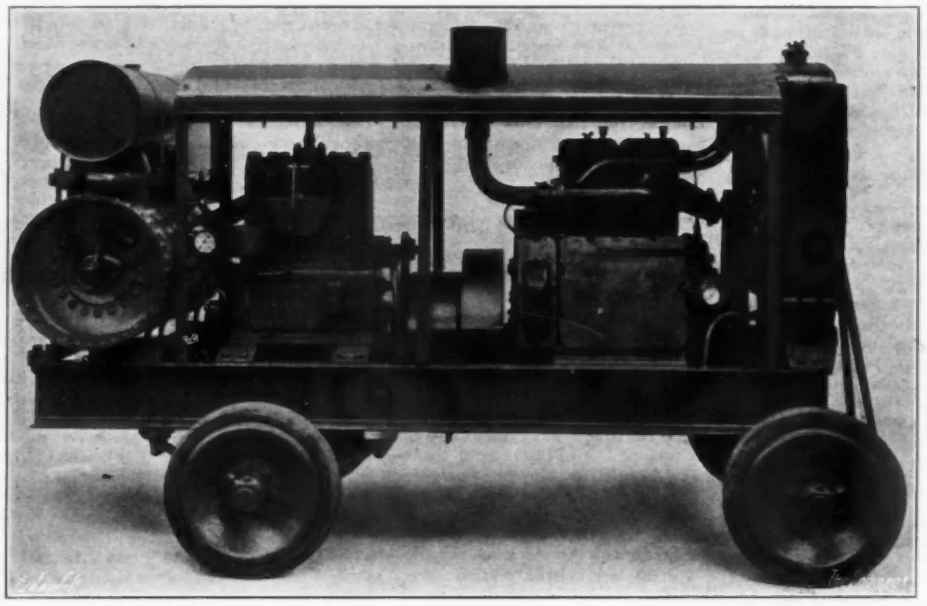

FIG. 1—PORTABLE OIL ENGINE DRIVEN AIR COMPRESSOR—BROOM AND WADE

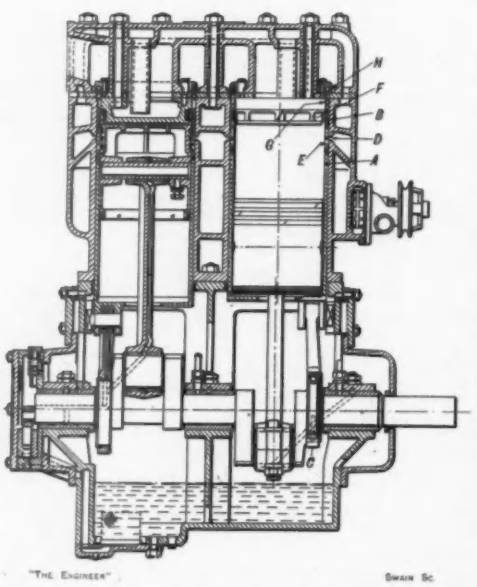

FIG. 2—SECTION THROUGH COMPRESSOR CYLINDERS

At the end of the stroke the sleeve cuts off the annular space G from the cylinder. The chamber is then filled with air at working pressure, and the only air left in the cylinder is that between the top of the piston and the cylinder head, which amounts to only 2 per cent. of the volume swept by the piston. This ensures a higher volumetric efficiency than can be obtained with a plate valve machine in which the clearance is usually about 6 per cent.

The excentric operating the sleeve is set approximately 130 deg. behind the crank pin, so that when the piston is on the suction stroke, the sleeve continues to travel upward until the air in the annular space G is delivered through the non-return valve H into the service line. This annular chamber is so proportioned that when the sleeve again recedes any residual air is expanded to the pressure of the air in the cylinder, thus obviating any eddies which would be produced if two spaces under different pressures were put in communication.

The non-return valve, which is a thin flat plate, is larger in diameter than the cylinder, and owing to its size provides an opening of ample area with a very small lift. The action of the sleeve also has the effect that the valve has 160 deg. of crank angle to open and close in, as compared with 40 deg. in an ordinary plate valve. From this it will be seen that although the compressor may be running at 1200 r.p.m., the non-return valve is operating under conditions similar to those of an ordinary plate valve compressor running at 300–400 r.p.m. The life of the non-return valve plate is therefore greatly extended, and it can be relied upon to keep sound and tight.

The engine, which drives this unit is of the new type which has been evolved by R. A. Lister and Co., Ltd., of Dursley, to which we have previously made some reference. The actual engine of the compressor exhibited is of the two-cylinder type, and is illustrated by the line drawing—Fig. 3. (It will be noticed that this drawing shows only one cylinder, but the construction is duplicated in the second cylinder.)

Apart from one or two minor details, the general construction of this engine is normal, and conforms to modern practice in high-speed internal combustion engines. A Lister head, incorporating the special Lister combustion chamber, carries an overhead valve gear, which is operated by push rods from a cam shaft driven by spur gears, running in the crank case. The crank case is of stiff section cast iron, the water jacket being cast integrally with the base. Two inspection doors are provided, one on either side of the crank case. By removing the door on the cam shaft side, immediate access is obtained to the cam shaft, tappets, big-end bearings, and centrifugal governor. This same door also incorporates the lubricating oil filler, the dipstick, and the exhaust valve lifting device. The lifter consists of a rod with a chamfered end, which, when pressed in, is pushed under the mushroom-shaped cam follower, lifting it and thus partially lowering the exhaust valve off its seat. At each end of the crank case, detachable bearing housings carry the main bearings, which are of the phosphor bronze type, solid and white metal lined. At the rear end of the engine, in the crank case, a bevel pinion is fitted on the crank shaft, which engages with a bevel gear for driving one end of the cam shaft. This bevel gear also carries the governor weights, so that, as will be observed, the complete mechanism is totally enclosed and lubricated, yet easily accessible through the main inspection door. At the other end of the engine a small housing is bolted on with the bearing housing, carrying a bevel gear which meshes with a pinion carried on the other end of the cam shaft. This gear drives the fuel-injection pump, which is connected through a vernier coupling. The same gear also drives a vertical shaft which projects downward towards the bottom of the crank case, where it engages with a gear type oil pump bolted on to the crank case.

The cylinder water jackets are fitted with renewable close-grained centrifugally cast iron liners, which are machined all over and ground and honed internally. The liner makes metal-to-metal joints at the top of the block. At its lower end three grooves are turned and rubber rings are fitted to the two outer grooves. These rings form the lower joint between the cylinder liner and the block, and allow for the expansion of the liner. The cooling water circulates around the intervening space, and in the event of water leaking past the two rings, it would, of course, ultimately enter into the crank case. To guard against this, a small tell-tale hole is provided at the back of the crank case, at the level of the middle groove in the liner. Consequently, as soon as any water passes the top ring it is still kept from the crank case by the lower ring, but is visible immediately at the tell-tale hole referred to. Experience has indicated that leaks seldom, if ever, occur, but it will be appreciated that the consequences of such an event would be serious, and it is on this account that the safeguard is provided.

The piston is of "Y" alloy to B.E.S.A. specification, with three pressure and one scraper rings. The gudgeon pin is of the full floating type, tubular, of case-hardened steel, and is retained in position by spring clips which fit into annular grooves turned in the gudgeon pin boss. The connecting-rod is a high-grade steel forging with a big end diameter of 3in. Both end bushes are of bronze alloy, the big end being lined with white metal. The crank shaft is of high-grade carbon steel.

The detachable cylinder head, carrying the injector nozzle in addition to the valves and rockers, is of special close-grained cast iron. A copper washer makes the joint between the head and the cylinder liner, the water connections being effected by rubber washers. The tappets are forgings, case-hardened and ground. The push rods are tubular and fitted with hardened ends, ground and polished, the valve adjustment being effected by set screws on the rockers. The complete valve mechanism is enclosed, access to the rockers being obtained by removing the cylinder head cover.

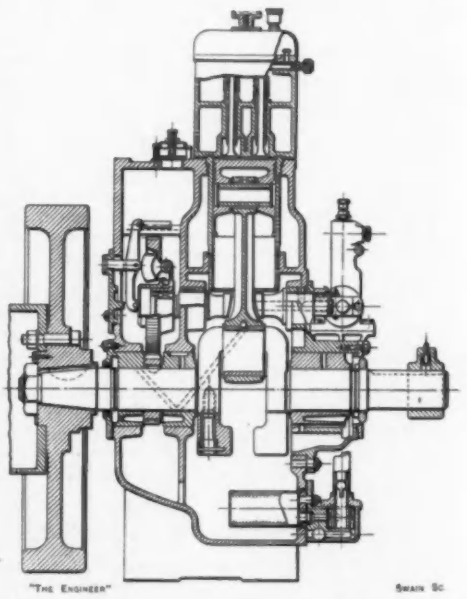

FIG. 3—LISTER OIL ENGINE

Lubrication is effected by a combination of splash and force feed. The oil pump draws oil from the

bottom of the crank case through a filter of generous proportions. As the oil pump is submerged, it is positive in action, and cannot draw air. From the pump oil is conveyed at a pressure of 8 lb. to 10 lb. per square inch, through an external copper pipe, to the gear-box casing at the end of the cam shaft. From there it is conveyed to the forward main bearing and pressure gauge, to the cam shaft bearing, and through the hollow cam shaft to the rear main bearing, rear cam shaft bearing, and big end. The oil mist from the crank and balance weight lubricates the cams, tappets and governor gear, and also rises up to the overhead valve gear.

The lubricating oil pump is fitted with an adjustment whereby the pressure may be increased to overcome any tendency to its failure on account of the ultimate wear in bearings. It is only necessary to clean the filter when dismantling the engine for overhaul. As an additional precaution, a greaser is fitted to lubricate the overhead valve rockers. The only other point calling for independent lubrication is the injection pump, which is provided with a small spring cap oil cup.

The governor weights operate on to a collar which in turn is connected with a horizontal rod parallel with the cam shaft. This rod projects through the crank case at the forward end of the crank shaft, where it presses on to a hardened pin carried on a bell crank lever, which is mounted on ball bearings, and carries a handle for manual control, and a stop pin for stopping purposes. The other finger of the bell crank lever is connected to a transverse rod coupled through a universal joint to the governor rod on the fuel injection pump.

The fuel injection system is effected by pumps of Bosch manufacture, and delivers a variable quantity of fuel to the engine, according to the position of the governor rod. The pump plunger is spring loaded and driven by a cam. When at the bottom of its stroke, two small ports allow the fuel to flow in under the action of gravity, thus filling the barrel. On the up stroke the plunger displaces the fuel back through the two ports until its top edge covers them. The remaining fuel trapped in the pump is forced through a delivery valve, into the injection pipe and into the cylinder, *vid* the injector nozzle. It will be seen from this that, since the injection pump is of constant stroke, its top edge will always cover the two supply ports at exactly the same position of the injection cam. Therefore, as the injection cam is positively driven from the engine, injection always starts at the same point in the cycle. So long as the ports are kept covered, fuel will be delivered to the engine. The plunger, however, has a helix cut around its periphery. Consequently, before the plunger reaches the top of its stroke, the helical edge of the annular groove has uncovered one of the inlet ports, which enables the enclosed fuel to take the path of least resistance, back through the port in the barrel to the main inlet port in the pump.

The radial position of the plunger is governed by a sleeve in which it works. The sleeve is fitted with a gear, which meshes with a rack on the governor control lever. Consequently, the position at which the by-passing of the fuel is permitted is controlled by the governor to suit the load. A special anti-drip device is incorporated in the delivery valve of the pump. The passage of the fuel through the open valve is effected through a central hole in the valve stem, and out through two diametrically opposed radial holes, which are uncovered when the valve has moved some way up off its seat. When the by-passing of the fuel takes place, the pressure in the pump immediately falls, and the valve returns to its seating. On account of the construction of the valve, however, the pump barrel is disconnected from the injection pipe before the delivery valve seats—that is, when the two small holes in the valve stem are covered by the valve guide. The additional movement of the valve down on to its seat actually makes a minor increase in the volume of the injection pipe, and consequently lowers the pressure therein, and stops any dribble at the injector nozzle.

The injector nozzle consists of two parts, the nozzle and nozzle holder, which can be rapidly dismantled whenever cleaning is necessary. The nozzle valve is kept on its seat by means of a spring, the tension of which can be adjusted from outside the nozzle holder. This spring, which controls the injection pressure, is set at the maker's works, and even when cleaning it is unnecessary to tamper with this setting. In case an alteration should be made, however, a gauge is supplied with each engine, which ensures the original pressure being attained. Any slight leakage which occurs and accumulates in the nozzle holder is led away into the inlet port, whence the surplus oil is taken into the engine. The lower end of the injector makes a joint with the cylinder head through a copper washer, whilst the top end has a rubber joint. The circulating water cools the injector barrel.

This engine has been put through vigorous and extreme trials, and a valuable feature that has thus been discovered is that a change in the brand of fuel employed does not call for any alteration in the mechanism, neither in injection timing nor in the pressure. This is obviously a valuable feature, as an engine which is tested at the works on any one brand of fuel will, we are told, function successfully when operating on another brand.

The consumption is guaranteed to be 0·45 pint per B.H.P. hour in the case of the one, two, and three-cylinder engines, and 0·43 pint per B.H.P. hour in the case of the four-cylinder engines. Under favourable conditions, however, as good as 0·44 pint, 0·41 pint, and 0·40 pint per B.H.P. hour may be obtained from the one, two, three, and four-cylinder models respectively. Actually, even better figures than these are obtained in practice.

Submarine Signal Company.

The exhibits of the Submarine Signal Company, of Victoria-street, London, comprise several types of Fathometer depth-sounding apparatus, electrically operated submarine signal transmitters, and submarine signal-receiving apparatus. The photograph reproduced in Fig. 5 shows the appearance of the Fathometer indicator fitted on the bridge of the ship in which the apparatus is installed. In brief, the principle of the device is as follows:—Sounds are produced by an oscillator at the bottom of the hull of the ship and travel through the water to the sea bottom. The echo resulting from the reflection of the sound waves is picked up by a hydrophone, also fitted to the bottom of the ship. The velocity of sound wave transmission in water varies very little, so that a measurement of the time necessary for the sound waves to travel to the sea bottom and return to the hydrophone is all that is necessary to determine the depth. In practice, the instrument is constructed to read in fathoms direct.

The diagram in Fig. 6 shows the arrangement of the various parts. Behind the indicator there is a small constant-speed electric motor, which can be started by closing the line switch A. A disc having a radial slot cut in it is mounted on the end of the motor shaft, which also carries a neon tube C, so arranged that when alight it shines through the slot on to the indicating scale of the instrument. The motor also drives a cam which, once per revolution, opens an electrical contact D, at the moment when the slot in the disc and the neon tube are opposite the zero of the scale. The opening of the electrical contact allows the oscillator E to transmit a signal of short duration. The sound waves echoed from the sea bottom are detected by the hydrophone F, with the consequence that a voltage is generated in its circuit. The current is amplified sufficiently to cause the neon tube to glow. Owing to the fact that time has elapsed since the signal was transmitted, the slot and the tube will have travelled some distance beyond the zero reading of the scale, and the reading of the scale opposite to the light flash indicates the depth. As the disc on which the neon tube is mounted makes several revolutions a minute, a series of light flashes is obtained, so that the depth is measured almost continuously. The only adjustment is that required to make certain that the speed of the motor, which is controlled by a governor, is properly synchronised with the intervals on the scale.

The hydrophone and the oscillator are usually placed in tanks fixed to the side of the ship internally, filled with fresh water, while the rest of the apparatus can be accommodated in any convenient place, such as the chart room or the pilot house.

In Fig. 4 a photograph showing the apparatus made by the firm for the reception of submarine signals and the determination of the distance of synchronous signalling stations is reproduced. If a submarine signal is synchronously transmitted at the same time as a wireless signal, a measure of the time interval occurring between the reception of the two signals provides an indication of the distance of the transmitting station. The apparatus here illustrated consists of a box containing the detecting and amplifying arrangements and connections by which the telephones are connected to both the wireless receiver and to the microphone at the same time. The operator can then listen, stop watch in hand, to hear first the wireless signal, followed by the submarine signal, when a simple calculation from the times indicated on his watch will give him the distance. To increase the accuracy of the observation and to relieve the operator of all calculation, the Submarine Signal Company has added an accurate clock, the face of which reads directly in nautical miles. On hearing the wireless signal the operator depresses a button at its side, which not only starts it going, but also cuts out the wireless signals, so that the arrival of the submarine waves may be more easily detected. As soon as the latter are heard the button is released, when the reading of the clock gives the distance.

Alfred Graham and Co., Ltd.

One of the exhibits of Alfred Graham and Co., Ltd., of St. Andrew's Works, Slough, is the navigation

FIG. 4—DISTANCE FINDING EQUIPMENT—SUBMARINE

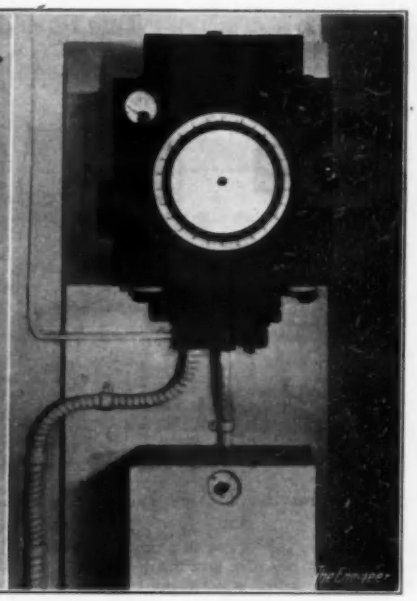

FIG. 5—FATHOMETER—SUBMARINE

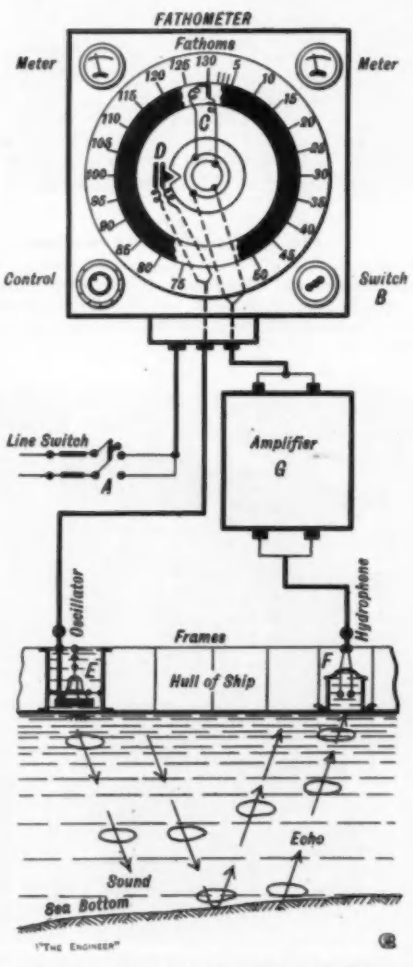

FIG. 6—ARRANGEMENT OF FATHOMETER—SUBMARINE

lights indicator, shown in Figs. 7 and 8 for indicating the condition of the navigation lights on a ship. When all the lights are burning correctly, the five pilot lamps, shown in Fig. 7, glow dimly, but, in the event of one or more of the lights failing, the pilot lamp for the particular light or lights ceases to glow and the alarm bell rings, giving both an audible and visual signal. As the pilot lamps show different colours—white for steaming lights and red and green for port and starboard lights respectively—the particular navigation light that has failed can readily be ascertained. Should a navigation light fail, the alarm bell continues to ring until the door of the case is opened, and the alarm bell switch is placed in the "off" position. The open door serves to indicate that a repair is being executed and that the audible alarm is switched off. The closing of the door after the repair has been carried out automatically moves the alarm switch into the "on" position, thus energising the alarm system. A defective pilot lamp

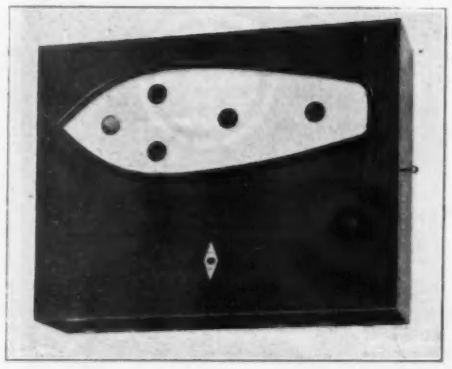

FIG. 7—NAVIGATION LIGHTS INDICATOR—GRAHAM

will not cause the operating coil to overheat. All navigation lights are simultaneously switched on and off by means of a main control switch, which is manipulated outside the case, thus permitting the case to be locked under normal working conditions and avoiding the possibility of the seaman failing to place any particular switch in the on or off position, as may happen when the lamps are controlled by independent switches. The indicator, which complies with Lloyds' requirements, has the contour of a ship worked in brass and outlined in black on the door of the case which houses the operating coils, the alarm bell and its switch, the pilot lamps and the main control switch for the navigation lamps. Double-pole switches in each lead inside the case permit one or more circuits to be isolated for repair.

Among other exhibits on this stand is a new unit which is now fitted to the Graham Navy telephones

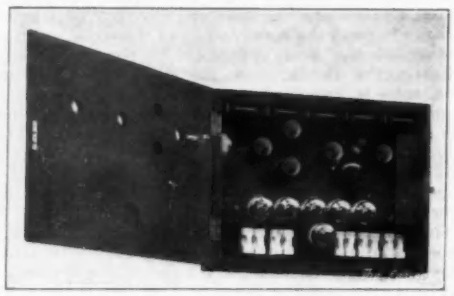

FIG. 8—INTERIOR OF LIGHTS INDICATOR—GRAHAM

for increasing the volume and articulation, and a new telephone of the open transmitter type, specially designed for use in noisy places. Mention should also be made of the firm's loud-speaking "Multiphones," which give excellent volume at one or more points up to a maximum of six points without the use of valve amplifiers. All that is necessary to operate these instruments is an 18-volt battery. There is also a "multiphone" alarm apparatus working with an amplifier, which provides means for speaking and giving an alarm at eighteen or twenty positions. In the event of failure of the power supply or breakdown of the amplifier, the apparatus automatically changes over to direct unamplified working.

C. A. PARSONS AND CO., LTD.

The chief exhibit of C. A. Parsons, and Co., Ltd., of Heaton Works, Newcastle-on-Tyne, is a 250-kW geared turbo-alternator with surface condenser arranged as a self-contained unit, as shown in Figs. 9 and 10. The set is a standard product, and constitutes one of a range of the "uniplane" sets manufactured for outputs up to 3000 kW, and designed for one-man operation. It will be seen that, in accordance with usual practice, the turbine, gearing and alternator are arranged in the same plane, but the condenser, instead of being underneath the turbine, is placed alongside it. The arrangement possesses many advantages, and when the space needed for withdrawing the condenser tubes is taken into consideration, the set calls for the minimum cubical or superficial space. An automatically controlled governor valve is directly operated from the speed governor without the interposition of an oil relay, and there is a combined runaway and stop valve. The impulse reaction blading is made from stainless iron. At the normal turbine speed of 9000 r.p.m., the alternator runs at 3000 r.p.m. The gearing is cut by the Parsons patented "Creep" method, and is said to be very silent in operation. In order to avoid any error in alignment being produced by sinking or movement of foundations, the bottom half of the gear case is cast in one piece with the oil tank bed-plate and bottom half of the cylinder, and it will readily be perceived that the design simplifies erection.

Another exhibit is a one-twelfth scale model of a geared turbine mill, representing a power installation in a Lancashire cotton mill. The actual plant from which the model was made was installed in 1914, and has been working satisfactorily ever since.

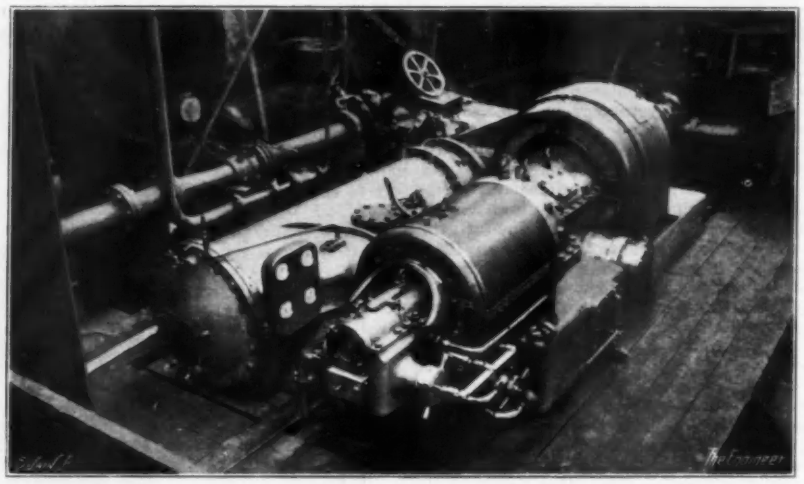

FIG. 9—250-KW UNIPLANE GEARED TURBO-ALTERNATOR—PARSONS

The normal duty of the plant is 2300 B.H.P., which is obtained from high-pressure and low-pressure turbines arranged on either side of a central low-speed gear wheel, which drives the main rope pulley at 250 r.p.m. On account of the high fuel economy, smooth turning moment, constant speed, powerful starting torque, and low upkeep charges, this type of mill drive, with or without ropes, is becoming increasingly popular in textile mills, paper mills, jute mills, &c. Many such plants have been built at the Heaton Works, for operation in this and other countries.

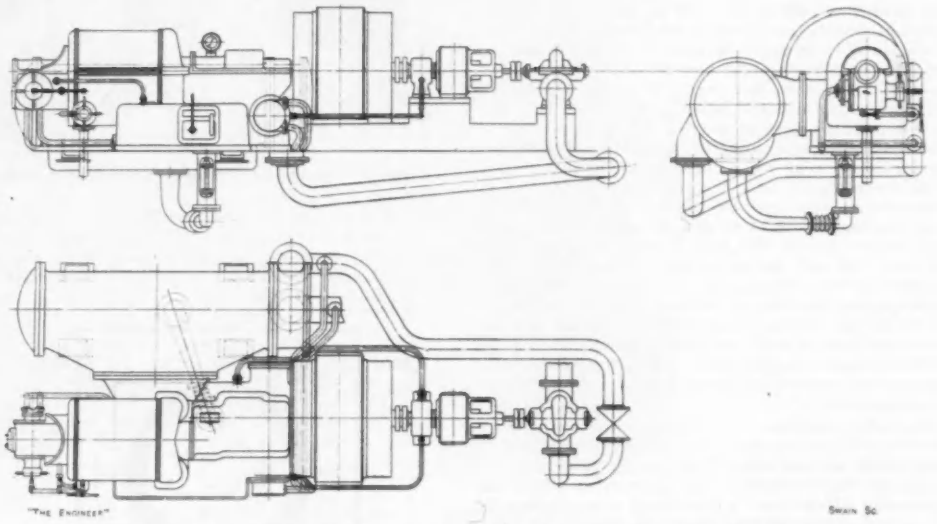

FIG. 10—GENERAL ARRANGEMENT OF 250-KW TURBO-ALTERNATOR—PARSONS

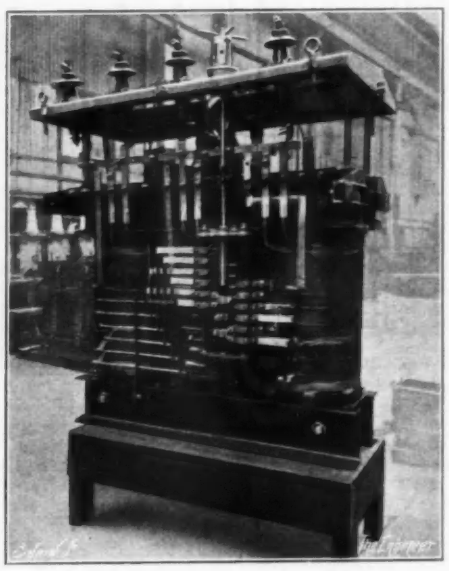

FIG 11—800-KVA TRANSFORMER—PARSONS

Searchlight reflectors and silvered glass mirrors, which have been one of the firm's standard products since the formation of the Heaton Works in 1889, are exhibited. There are parabolic reflectors of various diameters, and a split parabola ellipse reflector is mounted so that two beams can be obtained at the desired angle to one another. This is a type of reflector especially suitable for navigation of canals and rivers by night, when it is necessary to have a beam which will light up the buoys at the sides of the canal and at the same time leave a dark centre so as to prevent the pilot of an approaching vessel being dazzled by the light from the projector.

Besides several small exhibits showing the most modern system of reaction blading, there is an 800-kVA transformer, 3000/440 volts, fitted with off-load tap-changing switch, and a view of this transformer removed from its case is shown in Fig. 11.

ED. BENNIS AND CO., LTD.

The exhibits of Edward Bennis and Co., Ltd., of Little Hulton, Bolton, include examples of the mechanical stokers with which our readers are familiar, and one of the new travelling grate stokers, as described in THE ENGINEER of July 10th. This stoker, it will be remembered, is characterised by the small space between the bars, which enables very small coal to be burned, and at the same time provides access for ample air for its combustion. Arrangements are made for the recovery of partially consumed fuel, which may drop through the grate, so that it may be returned to the fire, while the distribution of the forced draught under the grate is

under local control, to enable a level bed of fire to be maintained.

It is noteworthy that this firm, which has always been associated with boiler-house equipment, has now embarked on a new branch of industry, and will show some plant connected with "wash-houses" and laundries, such as boiling troughs, wash-house stalls, and centrifugal hydro-extractors.

SULZER BROS.

Two interesting Maag machines for gear cutting and gear grinding are shown on the stand taken by Sulzer Bros., of London, and a measuring equipment devised for the special purpose of isolating the different errors that may arise when cutting teeth and enabling a detailed examination to be made is also exhibited. For purposes of examination the errors likely to arise can be placed under the three headings, error of concentricity, of pitch, and of profile. Error of concentricity occurs when the bore upon which the gear runs is excentric with the pitch line circle, and it may lead to jamming at one point and

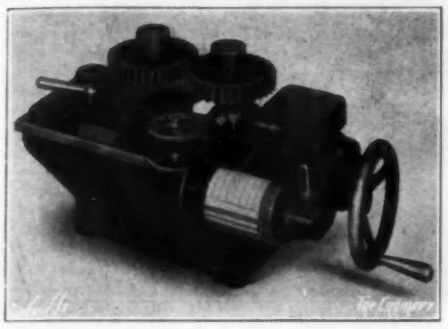

FIG. 12—GEAR TESTING MACHINE—SULZER

excessive backlash at another when two gears are in contact. Variations in tooth loading may also occur owing to the possibility of fluctuation in the angular velocity. The apparatus illustrated in Fig. 12 has been designed to detect such an error. The gear to be tested and a master gear are mounted upon two mandrels, the distance between the centres of which can be accurately set by means of a scale and vernier. The mandrels are carried upon slides, one of which can be moved about upon guides and locked in any position and the other of which can be set in a definite zero position by means of a taper plunger pin. When the gears have been accurately set up they can be rotated by means of the hand wheel, when any jamming can be detected. The backlash also can be examined by the use of feeler gauges. When concentricity is to be tested for, the locking plunger pin is withdrawn. A small spring is then allowed to act and presses the two gears into engagement. A recording device also comes into play. Any errors in

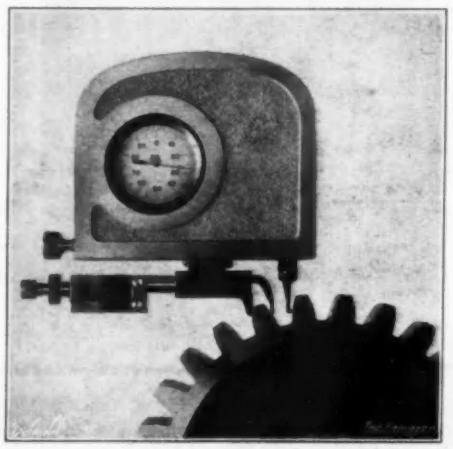

FIG. 13—GEAR TESTING MICROMETER—SULZER

the gears will cause the distance between their centres to alter, and a record of the movements is made on the paper wound round the drum, to be seen in the figure. Sudden jumps of the pointer are caused by pitch and profile errors. Excentricity, however, causes a gradual swing synchronous with the rotation of the gear concerned and occurring once in every revolution.

The instrument shown in Fig. 13 compares the shortest distance between adjacent teeth around a gear. It will be seen that there are three points of the instrument in contact with the gear. The one on the left is a locating face mounted on a slide and it is fitted with a finger to ensure correct placing. The remaining pointer is pivoted in such a way that by means of suitable gears its movements will be recorded on a dial reading to one ten-thousandth of an inch. When setting up the instrument the distance between the locating face and the recording finger is adjusted to be approximately equal to the distance between adjacent profiles by means of the finger screws provided. If the locating face is now placed against a tooth and the instrument is rolled upon this surface the recording pointer will travel down the profile of the next tooth. As it does so the distance between the locating face and the pointer will grow smaller, the variation being shown on the dial; but when the line of action of the gear is reached and passed the distance will again grow greater. The reading of the dial is noted at the moment when the distance is shortest—that is, when after its needle has been steadily moving in one direction it stops and begins to return. This reading is compared with those obtained from the other profiles, and the set of readings obtained gives an indication of how well the teeth will take up the load as they move into engagement. As all contact takes place along the line of action, the distance between adjacent driving profiles of the pinion and driven profiles of the wheel should be equal when measured along this line, and hence the instrument is capable of detecting the suitability or otherwise for engagement of two gears.

THE AILSA CRAIG MOTOR COMPANY, LTD.

One of the largest exhibits on the stand of the Ailsa Craig Motor Company, Ltd., of Strand-on-the-Green, Chiswick, is the four-cylinder heavy oil marine engine which we illustrate in Fig. 14. It is one of three

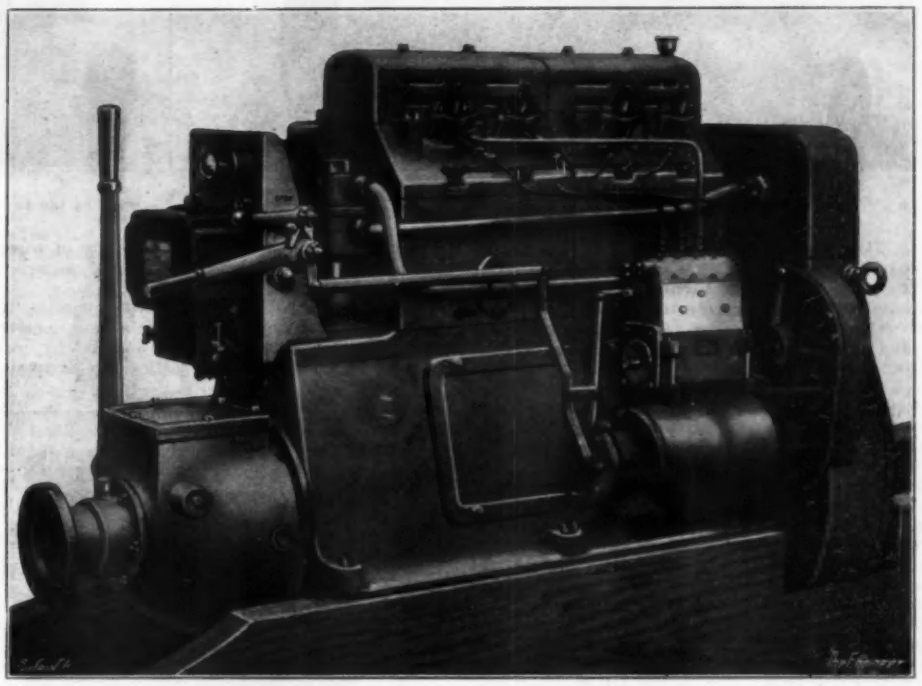

FIG. 14—40/60 B.H.P. HEAVY OIL MARINE ENGINE—AILSA CRAIG

standard sizes with designed outputs of 60 to 90, 40 to 60, and 20 to 30 B.H.P., with six, four, and two cylinders respectively. The larger six-cylinder unit is not shown, but both the four-cylinder and the two-

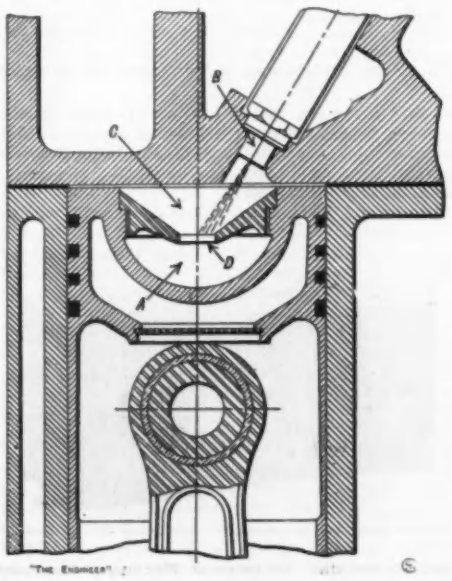

FIG. 15—SECTION THROUGH CYLINDER

cylinder units are exhibited and are illustrated in our Figs. 14 and 17. The engine operates on the Acro airless-injection compression ignition principle, which was fully described in our issue of June 10th, 1927. Fig. 15 is a section through a cylinder, which shows the principal feature of the design, an air cell A in the crown of the piston. The size of the air cell is so proportioned that, as the piston rises, about half the air in the cylinder is compressed into it. Shortly before the end of the compression stroke the fuel pump injects through the fuel valve B a finely divided charge of fuel into the heated air in the combustion space C, and ignition instantly takes place. By this time the piston begins to move down, and the air in the cell A rushes out through the narrow mouth D, breaking up the spray and carrying it throughout the space C in an intimate mixture of burning oil and air. The speed of the air flow through the orifice D is a function of engine speed, so that the speed of combustion is thus automatically regulated, the speed being determined by the load and the amount of fuel injected. The fuel pump, which is mounted over the governor on the starboard side of the engine—see Figs. 14 and 17—is of the Bosch standard pattern with standard fuel valves of the same make. The well-ribbed structure of the crank case shown in Fig. 16 may be noted. At the forward end of the crank case the fly-wheel casing and the gear-box for the governor and fuel pump drives are carried. The oil cooler is placed above the latter.

As our engravings indicate, large inspection doors are provided, giving easy access to the running parts. The cylinders and their heads are made in pairs, facilitating dismantling, while the pistons can be removed without disturbing the cylinders. The air for combustion is drawn through louvres in the cover, over the valve rockers, this space being vented to the crank case so that all fumes are drawn into the cylinder

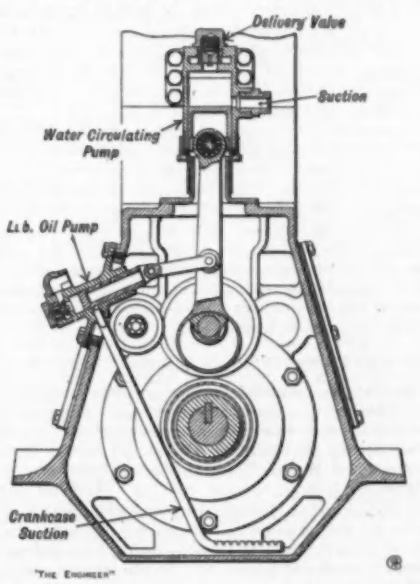

FIG. 16—ARRANGEMENT OF OIL AND WATER PUMPS

with the intake air, a cool and well-ventilated engine thus being obtained. A noteworthy mechanical feature of the engine is the arrangement of plunger pumps for lubricating oil and circulating water, which we show in Fig. 16. These pumps run at one-quarter engine

speed and are worked from a gear-driven excentric drive from the cam shaft, a port suction and a simple design of non-return delivery valve being employed. As our drawing shows, the lubricating oil pump draws the oil from the bottom of the crank case, after which it is delivered to the settling tank and oil cooler above the fly-wheel, from whence it flows to troughs arranged below each of the connecting big ends. This cool oil serves as a splash lubricant for the whole of the engine and gear case.

The engine controls are carried at the after end of the unit and arranged near to the starting panel. Starting on the larger engine is effected by a 24-volt 6 B.H.P. starting motor worked from two 12-volt 120-ampère batteries in series which are kept charged by a 24-volt 400-watt C.A.V. self-regulating dynamo working in conjunction with a constant-voltage control switchboard with push button control. For the smaller engine a hand starting device is provided. The engine cylinders are 4½in. bore with a stroke of 6½in., and the designed outputs of the four and two-cylinder models are 40 to 60 and 20 to 30 B.H.P., the speed range being 500 to 1500 r.p.m. in each case. The governor is so designed that when the hand lever on the starboard side is fully opened it runs on the determined governor speed, while when closed an idling speed of about 300 r.p.m. is maintained. The auxiliary lever immediately above the hand control lever, shown in Figs. 14 and 17, when disengaged from the main lever, shuts off the fuel pump and brings the engine to a standstill. The engines are equipped with the maker's standard design of reverse gear, and they can also be supplied with reduction gears of the standard 2 : 1 type or the special 3 : 1 type. Each gear is of the simple spur pattern with self lubrication and provision for taking up propeller thrust.

Other exhibits on the stand include examples of the firm's petrol and paraffin engines. We have chosen for illustration in Fig. 18 the four-cylinder petrol engine with a designed output of 40 to 60 B.H.P. Ten units of this type were recently supplied for South American Customs service launches. As shown, the controls are neatly arranged at the after end of the engine, which is fitted with reverse gear, hand starting equipment and a lighting dynamo.

An engine of unusual interest is the 20–35 B.H.P. four-cylinder model, a feature of which is the special design of cylinder head having the sparking plugs housed in a pocket. This particular design introduces an ordered turbulence which gives a more gradual rise of pressure during the first part of the combustion stroke. It also avoids the over-oiling of plugs. Large area valves are employed with a special design of hot spot manifold, which, together with a compression ratio of 5·5 : 1, enables the cheaper grades of petrol to be economically used.

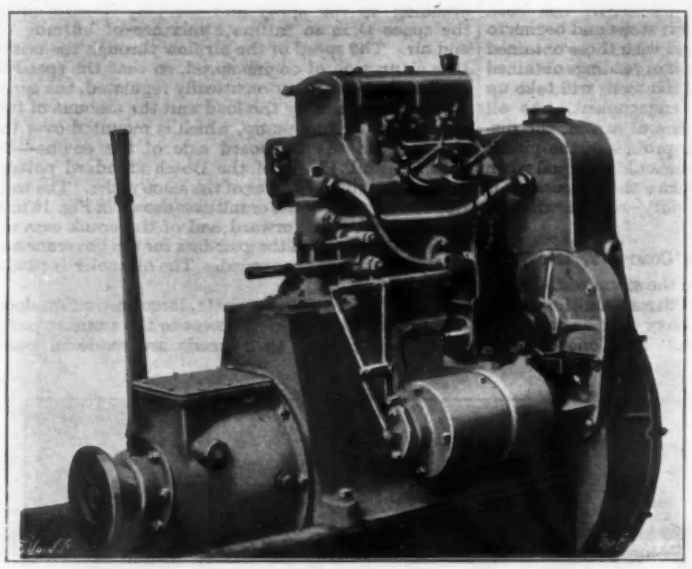

FIG. 17—20/30 B.H.P. HEAVY-OIL ENGINE—AILSA CRAIG

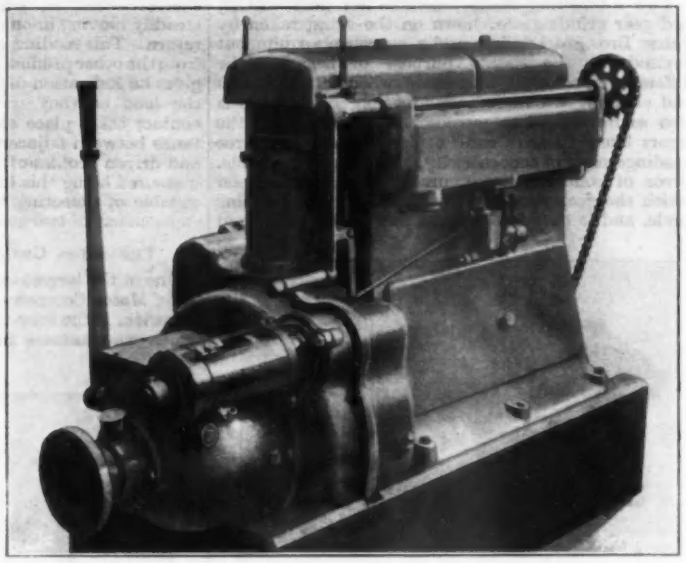

FIG. 18—40/60 B.H.P. 4-CYLINDER PETROL ENGINE—AILSA CRAIG

MARCONI INTERNATIONAL MARINE COMPANY, LTD.

The latest installations for wireless telegraphy and telephony, band repeater and music-playing equipment and the Echometer type of sounding device are to be found on the stand of the Marconi International Marine Communication Company, Ltd., of Marconi House, Strand, W.C. 2. Suitable cabins have been built to demonstrate in a practical way the minimum accommodation necessary on any class of ship to obtain the best results from the wireless and sounding device equipments. In the largest cabin is a newly designed powerful wireless installation for passenger ships. The main transmitter embodies units for generating long and short wave lengths, the high-tension supply being obtained from a common rectifier unit. Switches, within easy reach of the operator, facilitate the change over from one unit to the other and connect the appropriate aerial to the transmitter to be used. The valve receivers are equipped with special circuits which not only increase the range of reception, but eliminate to a large extent interference from nearby stations when distant reception is desired. A new Marconi direction finder makes the operation of taking bearings a very simple matter. The receiver and amplifier can quickly be adjusted to ensure a good signal strength for the purpose of taking bearings, and the wave range is sufficiently extensive to allow bearings to be taken, not only of wireless beacons and ship stations, but also of commercial and coastal wireless stations.

In the smaller cabins there are new wireless telegraphy and telephony transmitters and receivers, the design of which has been influenced by recent Conventions and legislation. They are particularly suitable for such vessels as cargo ships, yachts, coasters, trawlers, fishing boats and lifeboats. As it is impossible to exhibit one of the large passenger ship wireless telephony installations, photographs taken on ships are shown.

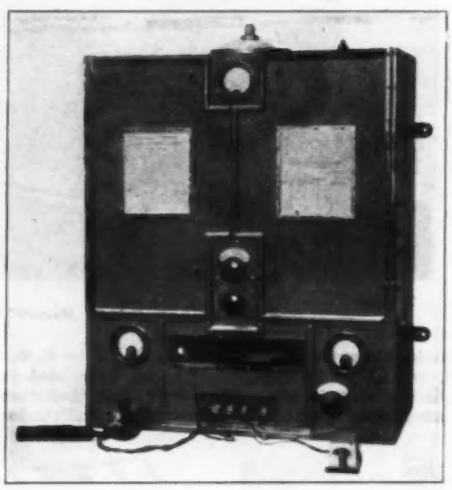

FIG. 19—300-WATT SHIP'S TRANSMITTER—MARCONI

The actual wireless telephone equipment which is exhibited is primarily for use on small boats where telephone communication is restricted to distances of 200 to 300 miles. A 300-watt wireless telephone and telegraph transmitter for ships is shown in Fig. 19, whilst a ship's receiver covering a wave length of 100 m. to 300 m. is shown in Fig. 20. The transmitter shown in Fig. 21 is for C.W. or I.C.W. telegraphy and covers a wave band of 600–800 m.

FIG. 20—MARINE TELEPHONE RECEIVER—MARCONI

The experience of the Marconi Company in generating and accurately controlling high-frequency oscillations has been extended to the sounding device, which, as its name implies, is an instrument for ascertaining the depth of water under the ship. The Echometer type of instrument which is exhibited uses the equivalent of a very low power wireless transmitter to send a signal from the ship to the sea bed, from which it is reflected back to the point of origin, the time taken between the instant of transmission and reception being translated into terms of fathoms and metres, which are visibly indicated at the top of the instrument box. This device is silent in operation and works from a 4-volt secondary battery. There is only one hull fitting, transmission and reception being effected by one unit, which is only about 1ft. in diameter.

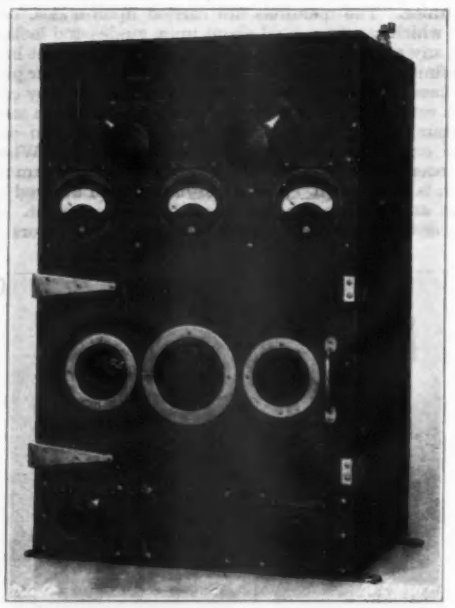

FIG. 21—½-KW SHIP'S TRANSMITTER—MARCONI

THE D.P. BATTERY COMPANY, LTD.

A display of "Kathanode" marine storage batteries, ranging from small cells of 40 ampère hours capacity to submarine cells of 8000 ampère hours capacity is to be seen on the stand of the D.P. Battery Company, of Bakewell, Derbyshire. An item of special interest is a section of a cell which shows the method of fitting the firm's patented "Kath Node" separators, which are composed of a combination of spun glass and wood or ebonite, and designed so as to prevent the loss of active material from the positive plates without interfering with the free circulation of the electrolyte. No fewer than 20,000 "Kathanode" cells, we are told, have been supplied for the operation of submarines. For signalling, gun-fire, and the lighting of ships, many of these cells have also been supplied. A matter of considerable importance at the present time is the emergency lighting of public and other buildings, and the company is showing a fully equipped automatic switchboard for this purpose.

(To be continued.)

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THE NATURE OF COMBUSTION.

SIR,—May I be permitted to commend the excellent leader on "The Nature of Combustion," which appears in the current issue of THE ENGINEER?

I have read this article with great interest, more particularly in view of the fact that I am engaged in the preparation of a volume on "Gas Power Engineering," in which I have included a section on "The Nature of Combustion."

Might I suggest that the explanation of the fact that combustion is in certain instances accompanied by an initial lowering of the temperature is perhaps more simple than we are inclined to look for? As I have pointed out in the section to which I refer above, from a consideration of what we might term the internal mechanism of combustion, we should expect a certain interval of time to elapse, after the combustible element has come into contact with the oxygen of the atmosphere, before combustion, and therefore before explosion, takes place. It is apparent, too, that theoretically there must be an initial lowering of the temperature.

Correctly defined, combustion is in the nature of a chemical union in which the heat produced is sufficient to raise the resultant substances to a temperature at which they emit light. In its more widely adopted sense, however, it is understood to mean chemical union between a combustible substance and oxygen.

We are interested mostly in the combustion of carbon, and bearing in mind that this element has a natural chemical affinity for oxygen, whatever the particular definition assumed, combustion is essentially a process consisting of two stages. Carbon is a monatomic element, while oxygen is diatomic, or, in other words, the molecule of carbon contains but one atom, while that of oxygen contains two. To be more precise in our definition of combustion, this chemical process is an act of union between an atom of carbon and an atom of oxygen, whether the combustion be incomplete or complete. Even in the latter case, when the result of the combustion is the formation of carbon dioxide, it is conceivable that union first takes place between an atom of carbon and an atom of oxygen, and then between the molecule of carbon monoxide so formed and a second atom of oxygen, since the arrangement of the atoms in the carbon dioxide molecule is in any case different from the arrangement of the two atoms in the oxygen molecule. Since a molecule is the smallest particle in which an element can exist in its free state, then it is but natural to suppose that if the molecule consists of more than one atom a certain amount of heat will be required to separate the constituent atoms of which such a molecule is composed.

When a molecule of carbon, consisting of one atom, is brought within gravitational distance of a molecule of oxygen, which consists of two atoms, there is, as we have seen, a chemical attraction existing between the carbon and the atoms of the oxygen molecule, and if the temperature is sufficiently high the attraction is great enough to result in chemical combination. The first stage of the process, however, must naturally consist of a separation of the atoms in the oxygen molecule. Heat is required for this, and it is obtained at the expense of the surrounding temperature. There is as yet no other source of heat, since none is liberated by the act of union between carbon and oxygen, as such union will not yet have taken place. This is, in fact, the second stage in the process of combustion, and the liberation of heat which takes place in this stage produces the rise in temperature which we have come commonly to associate with combustion. It is clear, therefore, that there must be an initial lowering of the temperature, and this arises purely from the fact that oxygen is a diatomic molecule.

It is equally apparent that there must be a time lag between the moment of contact between the carbon and oxygen and actual union between the carbon and one of the atoms of a particular oxygen molecule, since time is required to effect separation of the atoms in the molecules of oxygen. Further, this time lag will be shorter, the higher the temperature of the mixture. That this is so is due to the fact that separation of the atoms of the diatomic molecule of oxygen will be materially assisted at high temperatures by the centrifugal forces exerted by these atoms in virtue of the rotational energy of the molecules. It is well known that the molecules of a gas possess motion of three kinds—translatory, rotationary, and vibratory motion of the atoms and electrons. It can be shown that the rotationary motion is proportional to the absolute temperature and therefore the centrifugal forces tending to overcome the forces of cohesion between the two atoms of a diatomic molecule are proportional to the fourth power of the absolute temperature. In consequence of this, less heat will be required to effect the first stage in the mechanism of combustion at high temperatures than at low temperatures, and the time lag will necessarily be smaller, therefore, the higher the temperature. If the temperature were high enough we should expect the interval of lag to be negligibly small, in which case combustion would take place with extreme rapidity, and this is, in fact, the nature of an explosion.

In the experiments referred to in the above-mentioned article on "The Nature of Combustion" water was introduced into the cylinder instead of a combustible vapour, and it was remarked that no lowering of the temperature was observed. As a matter of fact, we should not conceivably expect one, for the vapour which would probably have been produced from the water has no chemical affinity for oxygen, and there was therefore nothing to induce the molecules of oxygen to separate their atoms one from the other.

For a similar reason, or perhaps rather because the inducement was not sufficient, there was no lowering of the temperature when spirit was introduced into a vessel filled with carbon dioxide. The attraction between the spirit and the oxygen of the dioxide was not sufficient to separate the atoms of the latter, and there would naturally be no lowering of the temperature.

At the lower temperatures mentioned in the experiments the interval of lag was so great that no explosion would occur at all, though combustion might still have taken place.

It is admitted that a more detailed consideration of the matter would perhaps be necessary in order that we might arrive at a true picture of the nature of combustion, but this would appear at least to afford a simple explanation of the phenomena observed in the experiments referred to.

E. W. C. WILKINS, B.Sc.
(Late Assistant to the Chief Engineer of the Ebbw Vale Steel, Iron and Coal Co., Ltd.).

September 2nd.

MAIN LINE ELECTRIFICATION.

SIR,—Your issue of August 28th contains three interesting comments on main line electrification in Britain.

The first, the "Journal" note under "Oil-electric Traction for Railways," is a summary of the brochure issued by a well-known firm of Diesel engine makers, and is, curiously enough, answered by Mr. Durtnall's letter on page 217, headed "The Commercial Fallacy of 'Diesel-electric' Railway Traction." Mr. Durtnall's criticism is true and severe, but he might have added that the extra powerful oil engine required to compete with the electric motor on gradients will not only be more costly to work than electric, but the capital cost will far exceed the sum suggested in the brochure quoted above.

But the third comment is made at the end of the paragraph "Automatic Sub-stations," page 224; this suggests that the question as between D.C. and A.C. for British main line electrification is still an open one.*

You are familiar with the Railway Electrification Committee's Report of 1927, in which D.C. is definitely recommended as the standard. The signatories to that Report, which include Sir Philip Dawson, the well-known single-phase expert, are sufficient guarantee that the recommendations were only made after considering the whole of the evidence put before the 1921 Committee, as well as that of 1927.

One great drawback to single-phase rail return systems is generally overlooked in making comparisons, and that is the impossibility of using communication circuits, especially telephone circuits, in the vicinity of the contact line. In this country it would be difficult and expensive to make the necessary alterations and renewals, and there is no certainty that an induction cure would result—see the Californian Railroad Commission Report.

The American Electric Light Association's Annual Electric Traction Report shows every year an overwhelming and increasing user of D.C. for traction. The outstanding exception—the Pennsylvania Railroad's extension to Washington and Harrisburg on single-phase—is probably due, at least largely, to the existence of the single-phase work put up by the Pennsylvania Railroad on the Norfolk and Western line, and particularly the extensive Philadelphia-Paoli, &c., electrification.

The American railways are under no obligation to standardise; they can do as they like.

The Pennsylvania experience of D.C. is, of course, limited to the short length from the New York terminal to the other side of the Hudson River. A statement by the Pennsylvania Railroad engineers confirmed by figures, showing why they are extending single-phase, would be of the greatest interest and value; but I fear this will not be considered practical politics.

Meanwhile we must respectfully bow to their judgment on their own case as that of a great railway, but nevertheless consider the majority judgment of the world as indicating the best practice and the trend of it to higher D.C. voltages.

It would be valuable, too, if reference could be given to Monsieur Parodi's alleged statement that he would not now use D.C. but A.C. if he had to start again. His paper on the Orleans electrification, read before the Institution of Electrical Engineers in 1926, contains no suggestion of this, so far as I can see.

May I suggest that the phrase "old ideas" in the third last line is more applicable to single-phase than to D.C.? Thirty years ago, when main line schemes were being outlined, it was considered that the D.C. tramway pressure of 600 volts was not high enough for economical distribution. D.C. motors for high pressures had not been made and were not even considered practicable; hence the decision, both in Europe and America, to use A.C. systems. The use of the transformer on the locomotive for single-phase systems enabled very high pressure to be used on the contact line, higher than is really necessary for economical distribution. It is the systems established in that early period which have—to avoid destruction of capital—been extended.

Fortunately in this country only two sections were put up (1907): the Brighton suburban and the Heysham-Morecambe, by the old Midland Railway. The Brighton has now been changed to D.C., and the Heysham line, though still running, will doubtless later also be converted to D.C.

The "old ideas" are therefore the A.C. single and three-phase, and the new ideas are D.C. 1500 and 3000 volts, automatic sub-stations, mercury arc rectifiers, &c.

The present writer regrets the need for anonymity, and only writes from a strong feeling that the question as between the systems in this country, historically and otherwise, is not always clearly understood.

September 3rd. M.I.C.E., M.I.E.E.

* There is nothing in the paragraph that warrants this deduction.—ED. THE E.

SIR,—An almost hysterical welcome has been given in some quarters to the Weir scheme, either from popular ignorance or for political purpose. And even a technical writer on other power systems has informed us that "the Committee have done great service to the country in pointing out that the non-condensing steam locomotive must give place to newer forms of traction."

After all this, Professor Lomonosoff's letter in your issue of August 21st, comes as a breath of fresh air—none the less so for its echo of the voice of "Old George," who also dealt with fundamentals rather than fancies.

And I would refer also to Robert Stephenson's fundamental comparison between the relative merits of fixed and loco-motive engines—quoted on page 425 of "A Century of Locomotive Building."

There is, too, an admirable diagram published some time ago by Goss, in his inspiring book "Locomotive Sparks." He shows what the locomotive engine provides to set off against its lower thermal efficiency as compared with a stationary plant—a point which condensing enthusiasts and others always ignore.

I venture to suggest that Professor Lomonosoff might illustrate this point, which is one of those he makes, by giving us a similar diagram comparing a modern steam locomotive with an equivalent power plant having all the latest accessories.

J. G. H. WARREN.

Bath, September 3rd.

COAL TRANSPORT CONDITIONS.

SIR,—In his article on "Coal Transport Conditions," in your issue of September 4th, Mr. E. T. Good repeats his claim—so often exposed—that British rail rates for coal are lower than those ruling on the Continent.

If Mr. Good were charged £5 for travelling from Sheffield to Rotherham, would he say that this was a cheaper rate than £6 for the journey from London to Paris and back? I think not. Yet that is the substance of his argument. The Polish rate of 3s. 4d. to which he refers is for a haul of nearly 400 miles; the British rate of 2s., of which he boasts, is for about 20. If Mr. Good would give the figures per ton mile—yes, Mr. Good, we will take note of the terminal charges if you will be good enough to separate them from the haulage rate—as they ought to be given, your readers would be better able to assess the truth of the statement that our export trade is handicapped by coal transport costs.

PHILIP GEE.

London, W.C. 2, September 7th.

[Mr. Good did not discuss the cost per ton mile, because his only object was to show the favourable position of British export coal with regard to total costs—pithead to bunker—as compared with foreign export coal, and to indicate the poor alternative that could be offered by canals.—ED. THE E.]

THE ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX.

THE eighth annual conference of the Association of Special Libraries and Information Bureaux will be held at Lady Margaret Hall, Oxford, from Friday, September 18th, to Sunday, September 20th, 1931. On Friday, at 6.45 p.m., the President and Council of the Association will receive the delegates and dinner will be served at 7.15 p.m. After dinner the President, Mr. H. T. Tizard, F.R.S., will address the company. A general session will be held at 8.30 p.m., and Professor A. M. Carr-Saunders will give a lecture on "Some Problems of Professionalism." On Saturday, at 9.30 a.m., at a general session, the following papers will be read:—"How the Manufacturer can Help the Librarian," by Mr. E. N. Simons; "Practical Methods of Arrangement, Indexing and Routine in the Business Library and Information Bureau," by Mr. B. M. Headicar; "International Abstracting and Indexing," by Colonel Sir Frederic Nathan, K.B.E.; and "An Ever-ready Printed Catalogue," by Dr. Albert Predeck. At 3 p.m. an exhibition of sound films will be given by the Western Electric Company. At 5 p.m. the annual general meeting will be held. At 8.30 p.m., a general session will be held and the following paper will be read:—"Films as a Medium of Information in Education, Science and Industry," by Mr. F. A. Hoare. On Sunday, at 9.30 a.m., a general session will be held, when Sir Francis Goodenough will give a short address on "The Report of the Board of Education Committee on Education for Salesmanship." Subsequently the following papers will be presented:—"The Publications of the I.L.O. and the League of Nations," by Mr. C. A. Macartney; "The Library and Information Department of the Royal Institute of International Affairs," by Miss Margaret E. Cleeve; "The Sources of Information in Agricultural Economics," by Mr. J. P. Maxton; "Documentation in Business Organisation," by Mr. G. A. A. de Voogd. At 3 p.m. an exhibition of sound films will be given by the Western Electric Company, and at 8.30 p.m. a general session will be held and the following paper will be read:—"The Russian Five-year Plan in its Special Relation to British Industry and Commerce," by Dr. E. Shenkman.

Press-Tool and Fixture Design.

By HENRY C. LANE.

No. V.—PROCESSION TOOLS.*

SECTION I.—PROCESSION TOOLS (i.).

Apart from straightforward blanking, piercing, or bending operations, combinations of these processes can be carried out by the use of what are known as "gang," "progression," "follow-on," or "procession tools." The actual blank is not completely cut from the stock in the first stage and the bar stock acts as an automatic feed for the later stages until the finished part is finally severed from the bar at the last stage. The pressing illustrated in Fig. 32 is an instance of what can be produced in this manner at

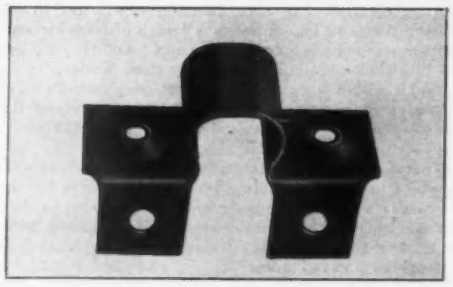

FIG. 32

the rate of one finished part for each blow of a direct single-action press. I cannot claim that I have actually produced these parts at the one operation. I merely know that they have been produced at this rate, and in a later article I propose to outline a principle of design that can be applied in most cases, show how the final design and pressing, though at first sight extremely complicated, are actually extremely simple, and shall endeavour to convey rules by which it will be possible to say in many cases immediately that a given part can be produced in one blow.

Apart from expansion of the metal due to shearing, it may be understood that procession tools are in

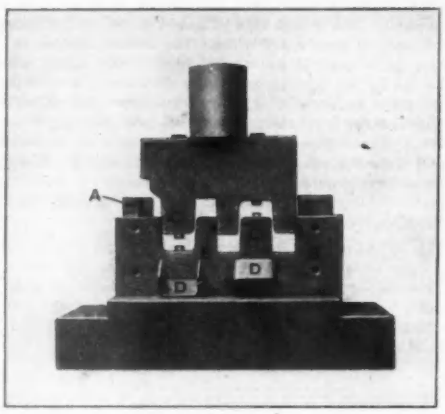

FIG. 33

reality a series of dies ranged end to end, the centres of each stage being the feed length of the blank apart. Each stage carries out a process on the metal stock, and yet leaves it free to be fed away to the next stage with accuracy and ease. Each part produced therefore has received as many press blows as there are working stages on the die, though one finished pressing is produced for each press revolution.

The tools illustrated in Fig. 33, producing the two bent collar straps D for use on the tools illustrated in Figs. 29–31, can hardly be called "procession tools," and are shown here merely to describe a cut

FIG. 34

and bend principle that is of considerable use in the design of procession tools. In this case the material is fed to the stop A, the male bending punches C and the shear edges B strike the metal at the same instant, and the two cut lengths cannot therefore get out of position for bending, which, as will be seen, is carried out on the "draw-bend" principle, small spring pegs being fitted to the punches and dies to strip the bent straps from each.

Fig. 34 shows end of bar stock and blank at A produced on the simple blank and pierce tools shown in Fig. 35. The bar stock is started by feeding to the press button stop C, and with the material in this position—the first stage—the small hole is pierced by punch B and hole B′. The metal then passes to the second stage gauging from the press button stop E and the locating peg *b*, situated alongside the punch D, passes through the hole already pierced in the stock and enters the hole *b′* in the die, accurately locating the stock for the piercing of the second hole

FIG. 35

D′ on the die. The third press button stop is used on the third and final stage, when commencing the bar, after which the final stop H is used. The two locating pegs *b* for the punches F and D position the stock accurately for work, and the finished blanks, passing through the hole F′ in the die, are separated from the scrap piercings from the holes B′ and D′ by a sheet metal chute fastened to the underside of the die shoe in a suitable position. It should be noted that when

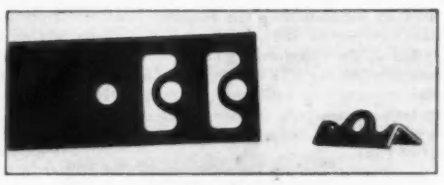

FIG. 36

locating pegs are used on the various stages, finger stops for starting the bar are absolutely essential to provide the holes in the stock necessary to accommodate the locating pegs.

Fig. 36 shows end of bar stock and blank of a simple pierce, cut-and-bend operation produced on the tools shown in Fig. 37, which has had the stripper removed, as was the case of Fig. 35, for clearer description. The bending principle is, in effect, very

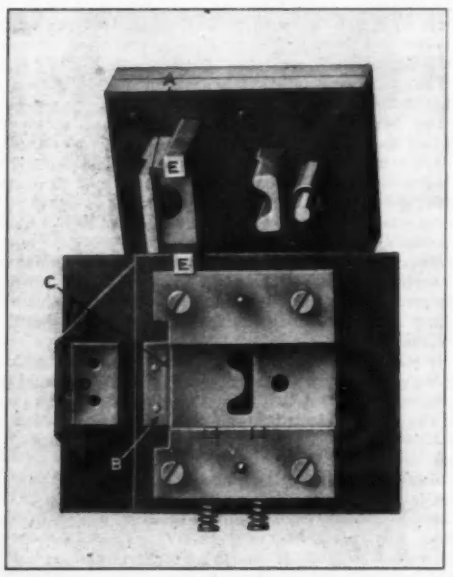

FIG. 37

much the same as that shown in Fig. 33. In these tools no special locating pegs are provided, and the finger stops are fitted solely to reduce the scrap on each bar by giving a complete three-stage start to each bar. The actual locating pegs are disposed of by lengthening the first stage piercing punch so that it is the first to strike the metal, and enters the die before the bending leg A of the bending punch exerts any pull on the metal in the direction of the feed as the "draw-bend" process over the form pad B is in action. The combined cut-and-bend punch of this final stage is supported by its legs E, and the combined bar stop and punch support D. The form pad B is a separate piece from the main die and the upper surface is lower than the shear edge C of the die by the thickness of the bar stock.

It was found that with the extreme length necessary for the first stage piercing punch it was advisable to build the punch up from a piece of ⅜in. silver steel slipped through a shorter ⅜in. silver steel collar. For this particular job punches made on this principle stood up to the work far better than those turned down from the solid, and I am inclined to think, owe their longer life entirely to the more even heating obtainable for hardening purposes. It should be noted that between the second and final stages on the tools is left a dummy stage. If this were eliminated repair

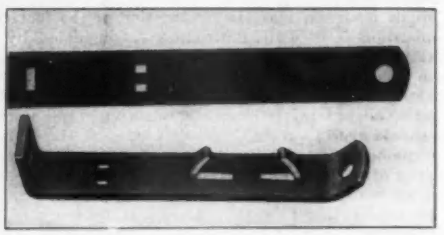

FIG. 38

costs would be heavy and continuous on account of the extreme weakness of the die between the second stage piercing hole and the final stage shearing edge of the die.

From the tools so far described it will be seen that it would be quite a simple matter to take the blank shown at A in Fig. 34 a stage further, putting in a bend as shown in the same illustration at A′. Instead of being blanked completely in the third stage the shape would be cut on the leading edges and just round the radius corners of the back edge, which in the main would be left attached to the bar stock for forward feeding to the final stage, which would be on exactly the same principle as the Fig. 37 tools, with the exception that a contour would be sheared in

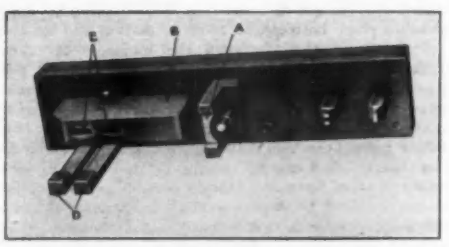

FIG. 39

place of the straight shear edge. Here also a dummy stage would be well advised to give adequate strength to the shearing edges of the die.

Fig. 38 shows end of bar stock and finished part of an apparently more complicated design carried out in the two-stage tools of which the punch is illustrated, in Fig. 39 and the die in Fig. 40. It will be seen that the bar is cut to a radius at one end, pierced with a ⅛in. round hole and bent at 45 deg. Two small rectangular holes are pierced and two tongues cut and bent upwards in the base of the pressing while the other end is cut off straight, pierced with a rectangular hole and bent at right angles. Examination of the blank will show that the difference in the shape of each end necessitated the shearing away of a small web of

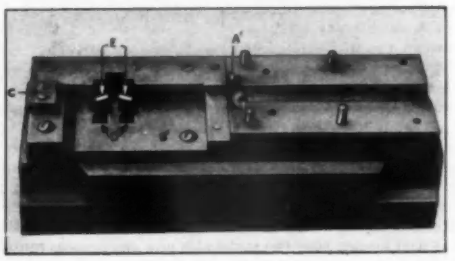

FIG. 40

scrap between each blank, and from this it followed that if feeding was to be managed with ease the two ends must be bent up rather than down, and therefore the male punches for the two tongues had to be located on the die shoe, not with the other male punches on the punch plate. Consequent upon these points it followed that some special stripping device would be necessary to remove the metal from the tongue cutting punches. It was also obvious that for ease of feeding the tongue punches should be as low down from the die surface as possible, and we have already seen the necessity of some form of pressure pad to prevent auxillary and unwanted bends occurring in tools putting more than one bend in the metal.

We now come to the main point to be borne in mind in designing procession tools—at the last stage the part must be severed from the bar and have its shape

* No. IV. appeared September 4th.

completed if the latter has not been done in earlier stages. In the first rough design, therefore, the finished part is visualised as having been cut off from the main stock and if the blank is studied it will be obvious that as both sheared ends are at an angle to the main bar of the pressing it must of necessity be a cut and bend stage similar to the second half of the tools illustrated in Fig. 33. A small pair of experimental tools were made to ascertain the height and shape of tongue cutting punches necessary to produce the finished shapes shown—the angle of each being slightly different from the other—and with the punch height known the bending die was made having the upper edge for the right-angle draw bend the height required for the tips of the tongue cutting punches, which were fitted in the desired position in the die and holes supplied for them in the form punch. The question of stripping had then to be decided, and it was essential that any stripping device must allow of the bar stock being fed forward on a horizontal level of the top of the bending die. Reference to the illustrations of punch and die in Figs. 39 and 40 respectively will show how the tools were thus completed. Two pairs of stripper legs D, of which one pair has been removed to show details, were fitted to the bending form punch B. These stripper legs are of a length that brings the tops of their feet level with the points of the tongue punches E which operate in the holes E in the bending punch. On the working stroke of the press the stripper legs pass through four holes D′ in the die, each tongue punch having a stripper leg on each side to obtain even stripping. The tongue cutting punches actually serve three distinct purposes and greatly reduce the complexity of the die design. In addition to the actual process work on the metal, they form an ideal pressure pad for the bending process and also act as gripping pegs to obviate the "creep" tendency present in the bending process and due to the uneven angles of the two bends at the ends of the part produced. From this it is quite simple to visualise the stage immediately preceding, when it is borne in mind that a piece of scrap must be removed from between the stages to produce the square cut on the one end and the radius cut on the other end of the part. The punch A working in the hole A′ is common to both stages and the remaining holes are pierced in the first stage, as will be seen from the illustrations of punch and die, from which latter the stripper plate has been removed. For ease in hardening and lay out the die is actually two separate and self-contained dies, brought together at the hole A′.

SECTION II.—PROCESSION TOOLS (ii.).

(*Elimination of the Factor of Stock Expansion.*)

When working in the thicker gauges, and more especially in the softer metals, multiple-stage procession tools will not give satisfaction unless accurate allowance is made for the expansion or lengthening of the metal due to the various cutting, piercing and bending processes. I have in mind a pair of tools that I designed some years ago to produce irregularly shaped blanks with a minimum of scrap. On the usual assumption of leaving a web of metal around each blank equal to the thickness of the stock, 32 per cent. of the total material used was scrap, and I discovered that without the web scrap the blanks would run in together so as to require 28½ per cent. less material than before. For a time, in fact until the first tools were completed, I overlooked the expansion of the metal, which was 10 s.w.g. soft brass, and as I employed a special means of locating the bar, this expansion rendered the tools useless. Two blanking holes were laid out on the die, separated by two complete stages, that is to say, that four complete blanks separated the two punches. The feed length of each blank was exactly ⅜in., four blanks packed tightly together measuring exactly 1½in. feed length. The actual material length required was, however, only 1 7/16in., which showed that expansion of the metal made up the remaining 1/64in. on each blank. This threw my second blanking hole out in the original lay-out by ⅛in., and to correct this I adopted a new principle of toolmaking. I split the die between the two blanking holes and hardened punch and die for the first stage. These parts I then set in a press and fitted a temporary but accurate feed stop and gauges. With the aid of these gauges I removed a series of blanks from a bar of the metal to be used in the tools, checked up to see that the feed length was in each case accurate and brought the other half die into position, having clamped the prepared bar end to the first die. The locating punches of the second half die were slipped through the bar end and the second die accurately located therefrom, clamped to the die shoe and subsequently screwed and dowelled in position. The punch carrier plate was then split in two, all punches slipped through, the first blank punch with its plate was attached to the main punch pad, all punches placed in position in the die, and the second half punch plate clamped to the main punch pad for screwing and dowelling. On this principle the various stages on procession tools can be brought into absolutely exact register after making the deadly accurate allowances for expansion by gauging from the worked stock for positioning the various die blocks and their punches. In some cases it will be possible to have complete independent dies; in others the method outlined below will produce better results. It may be necessary, when using separate dies or die blocks for overcoming the expansion factor, to provide dummy stages between certain working stages if the amount of metal on the working points is reduced to a point where undue wear or breakage is likely to result.

To explain my various points and methods more graphically I give in Fig. 41 a hypothetical blank that could be produced on a five-stage die as follows:—Stage 1, hole II.; Stage 2, dummy stage for greater die strength; Stage 3, hole I.; Stage 4, as Stage 2; Stage 5, blank sheared off bar by cutting on following edge only. Allowing full freedom of expansion to each of the six cut edges of the blank and writing the amount of each expansion as D we can produce the

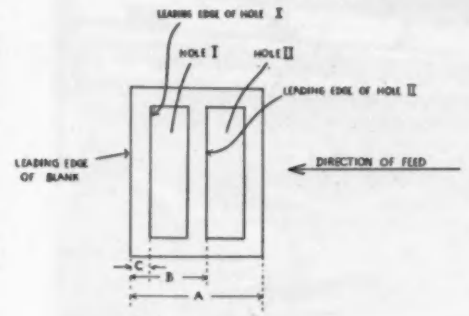

FIG. 41

following theoretical formulæ for the location of the various stages on the die, basing the formulæ on the number of parts in the material between two fixed points on the die which will eventually be expanded by shearing. Firstly, the actual length of material required for the blank is obviously (A−6 D). In relation to the final material stop the following distances for the stages are obtained:—

Stage 5—Shear edge (A−D).

Stage 3—Leading edge hole I. (2 A+C−5 D).

Stage 1—Leading edge of hole II. (4 A+B −15 D).

Compare this last measurement with that of a five-stage die composed of stage I., pierce hole II.; stages 2, 3, and 4, dummy stages; stage 5, cut-off bar; and for locating leading edge of hole II on the die we can use the formula (4 A+B−9 D). This shows that the inclusion of stage 3 as a working stage can, under certain circumstances, alter the lay-out requirements of stage 1 by 6 D, which in many cases will be found to be well over 1/32in.

If the value of D could be accurately determined beforehand, the lay-out of the die in one piece would be a comparatively simple matter, no matter how many stages were employed, but unfortunately this is far from being the case, and the rough sketch of a composite die block is given in Fig. 42, to show how it is possible to render important distances adjustable

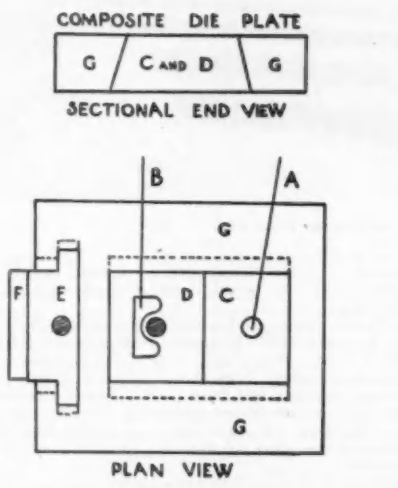

FIG. 42

after the dies and punches have been made and hardened. The lay-out of stages shown is to produce the blank shown in Fig. 36 on a deadly accurate basis. As will be seen, the block is composed of the first stage pierce hole A set in the small block C, a dummy stage is interposed between this first stage and the third stage pierce hole B in the adjoining block D and a second dummy stage is interposed between the third stage and the final cut and bend stage. The bending form pad F can be fastened direct to the main die shoe, while the three working die blocks C, D, and E are dovetailed into the main die block frame G, as shown in the sectional end view. Dowel holes—not shown—should be provided in each of the working stage blocks to facilitate definite anchorage after final adjustment of the stages, and each block can then be hardened and tempered. Adjustment of the various stage lay-out centres can be carried out either by the provision of suitable adjusting screws or by grinding the end faces of individual blocks, packing up each block accordingly from the opposite end. The punches should each be housed in separate carrier plates, which, in turn, can be mounted temporarily on a master dovetail pad. When adjustment of the die is complete, each punch carrier can be mounted in position on a common flat pad, the temporary dovetail pad being kept purely for purposes of lay-out adjustment of similar sets of tools.

In spite of the facilities offered for lay-out adjustment, it is advisable, where possible, to adjust approximately from knowledge obtainable from methodical sample works from the die blocks before adjustment. As an example, I will take the tools illustrated in Fig. 42, which will give six different values for D in the formulæ given for the blank in Fig. 41. These values can be conveniently referred to as U, V, W, X, Y, Z,

U being the expansion from the piercing of hole A towards the unworked end of the raw material.
V being the expansion on the blank at the final shear towards the final material stop.
W being the expansion of the bar from the final shear towards the piercing of the hole B.
X being the expansion from the piercing hole B towards the final shear.
Y being the expansion from the piercing hole B towards the piercing hole A.
Z being the expansion from the piercing hole A towards the piercing hole B.

These letters enable us to analyse the formulæ previously quoted, thus—

Material length for blank is (A−U−V−W−X −Y−Z).
Distance from final material stop to stage 5, shear edge is (A−V).
Distance from final material stop to stage 3, leading edge of hole B is (2 A+C−2 V−2 W−X).
Distance from final material stop to stage 1, leading edge of hole A is (4 A+B−4 V−4 W−3 X −3 Y−Z).

To arrive at the actual measurements for these six values, a number of test pieces of the material to be used on the tools will be required, and should be cut and filed to present dead square ends. The lengths of each piece should be taken to 1/1000th of an inch as a maximum, but preferably to half that figure, the various lengths suitably recorded, and the following procedure adopted:—

Pierce a test piece with one hole at stage 1, value for U is one-half the expansion of the stock length.

Place two test pieces, each 1½ times blank length, end to end over stages 1 and 3, lower press by hand until punches for each stage lightly grip each test piece, tap test pieces tightly together, taking care not to damage ends for subsequent measuring purposes; pierce; compare stage 1 piece with original length; and the difference less the ascertained value for U is the value for Z. Repeat the U valuation process on stage 3 to ascertain the free expansion value, and deduct the half as above from the increase in length on the stage 3 piece to ascertain the value of Y.

Using inside micrometer, set the final stop to dead material length of blank from shear edge of die.

Place two test pieces, each 1½ times blank length, end to end to cover stages 3 and 5; bring punches down by hand to grip stage 3 piece, which is then tapped tightly up to stage 5 piece, which, in turn, is pushed and held up against the final stop; pierce and cut off test pieces; the measurement of piece sheared to final stop, less measurement between stop and shear edge, is the value for V. Total measurement of original stage 5 piece, less measurement between stop and shear edge, deducted from measurement of short piece sheared and left on die surface, gives value for W. Measurement of stage 3 piece less free expansion factor, as ascertained in finding the value for Y, gives on the same principle the value for X.

If the three dies and final stop with their corresponding punches are located and packed in the positions indicated by the formulæ given as connected with these expansion factor values, a close approximation to the desired result will be obtained if the tests have been carefully and accurately carried out. Some slight adjustments may be necessary. To do this it is advisable to check off each stage in relation to the final material stop and work backwards through the various stages. That is to say, that in the case in point the bending punch would be removed and the length of the blank cut off at the fifth stage would be checked. If correct, stage 3 would be tested and, if necessary, adjusted to agree with the final stop and the final shear, and, lastly, stage 1 would be tested and adjusted to the two following stages and the final stop. In all tests the material used must naturally be that which the tools are designed to work.

As soon as the dies are definitely adjusted to the ideal lay-out, the dowel holes provided in the various blocks prior to hardening should be continued into the die shoe and suitable dowels slipped into position. The various punches in their separate carriers are then slipped into their respective dies, trued up, and screwed and dowelled to the regular main punch pad.

(*To be continued.*)

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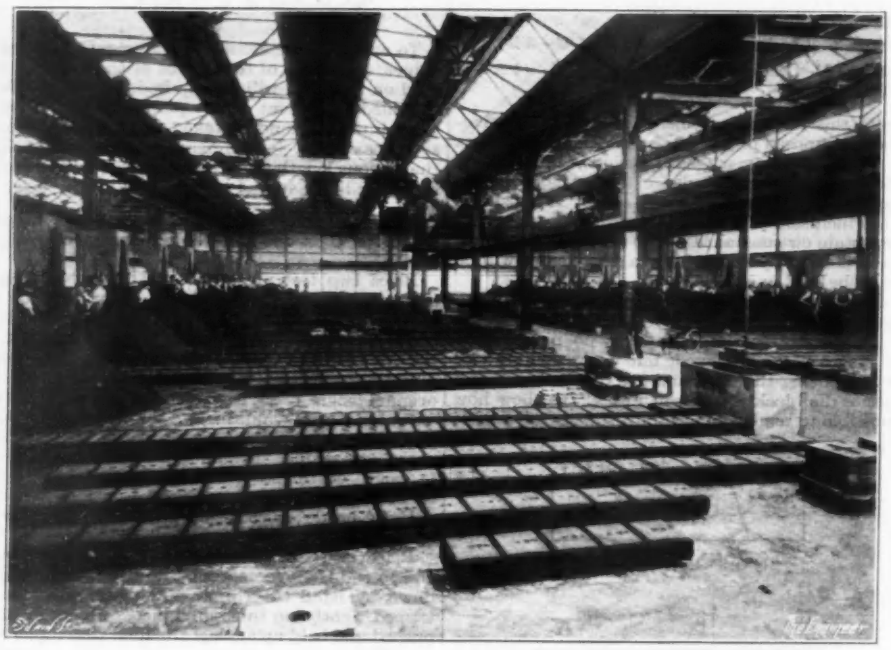
JOHN HARPER AND CO., LTD., WILLENHALL

STORES AND DESPATCH DEPARTMENT



HYDRAULIC MOULDING MACHINE SECTION

A New Ironfoundry.

THE two photographs which we reproduce above represent two distinct departments of the new foundry which has just been added to the works of John Harper and Co., Ltd., of Willenhall, Staffs., and indicate, not only the extent of those shops, but also the pains which have been taken in their design to eliminate unnecessary labour.

The foundry is intended for the production of comparatively light iron castings, such as those used in the electrical equipment trade, and has been planned for an annual capacity of 7500 tons of castings.

The buildings cover a total area of 875ft. by 310ft., and the foundry itself measures 600ft. by 180ft. It is served by a cupola of the balance draught type, built according to the designs of the British Cast Iron Research Association, which is capable of melting from 10 to 12 tons of iron per hour. The cupola is placed midway along the length of the foundry and is served by a crane equipped with an electro-magnet for lifting the pig and scrap. There are overhead bunkers for the reception of a day's supplies of materials, which are delivered to the cupola by drop-bottom buckets after passing over a weighbridge. The molten iron is tapped off into 8-cwt. ladles carried on Morris runways and is taken to convenient points, where it is poured off into hand ladles for feeding into the moulds. There are also, in the main bay, where the heavier castings are made, a 2-ton Morris crane and a system of rails which extend to the other bays, for Hayward 1-ton telpher cranes. Each line of moulders has been provided with two lines of these rails, one passing over the benches or machines, so that facing sand may be distributed, and the other passing on the gangway side for collecting scrap. The cranes are transferable from one line to another by a transporter bridge, and foundry scrap, after once being loaded into the drop-bottom buckets, can be carried directly to the cupola and charged without further handling.

The moulding sand is dealt with by a battery of mills by August's Muffle Furnaces, arranged near the centre of the foundry. From these mills there radiates a series of conveyors, which take the various qualities of sand to storage hoppers, and from these hoppers it is distributed by telphers to smaller hoppers convenient to the work of the moulder. The used floor sand is brought back to the plant by the same telphers and reconditioned for further service.

In the way of moulding machinery there are on one side of the cupola ninety hydraulic-squeeze moulding machines, some of which are shown in one of our illustrations, which were made by Messrs. Berry, of Leeds. They work with a water pressure of 700 lb. per square inch and have stainless steel cylinders. The valve connections are all readily accessible above ground. In the same bay there is also a pair of U.S.S.M. down sand frame machines for the intensive production of castings for gas and electric cookers. On the opposite side of the cupola there are a variety of pneumatic moulding machines, including those of the Osborn turnover type for the production of stators and similar work.

Moulding boxes and such-like materials are stored in a bay adjoining the foundry, which is 400ft. long, and transport is provided by a Lister truck. There are also the pattern stores, which occupy an area of 50,000 square feet on three floors. It is noteworthy that the patterns are always carefully inspected, both on reception and issue, to see that they are in good order.

Behind these stores lies the pattern shop, a light and airy building, equipped with modern machinery for dealing with pattern work, and especially for metal pattern plates, which form so large a part of the equipment for repetition castings. There are various lathes, planing machines, saws and equipment for the fitting up of moulding boxes. The melting of gun-metal and white metal for plates is carried out in a small experimental shop, where also new jobs are tried out and perfected before being handed over to the foundry for production.

The core shop is of large dimensions, with sand drying and mixing machinery mounted on a platform at one end, whence it is distributed around the core benches by tilting buckets carried on a pendulum conveyor. Provision is also made for ground sand from the August mill to be brought into this shop by a Morris runway and re-distributed on the conveyor in specially marked buckets for use where required. The cores are dried in a battery of oil-fired stoves, erected by Peneulec Ltd., each being equipped with a temperature recorder.

After leaving the foundry the castings are taken by an elaborate system of roller conveyors through the fettling and sand blasting departments to the store and despatch department, which we also illustrate.

In the power-house of the works there are the step-down transformers for the electrical supply taken from the public mains and the appropriate switchgear, a Belliss and Morcom engine using steam at 160 lb. per square inch and exhausting at 10 lb. per square inch for heating purposes which drives a generator in parallel with the main supply, and a Babcock boiler fired with an Alfred Herbert coal pulveriser, capable of evaporating 10,000 lb. per hour. There are also Belliss and Morcom air compressors driven by electric motors designed to correct the power factor of the general works network and give unity power factor. The hydraulic pumps for the moulding machines are also situate in the power-house.

Moving an Engineer's Supply Warehouse.

SOME indication of the convenience of the container system of conveying goods by rail is given by an operation recently carried out by the London, Midland and Scottish Railway for Charles Churchill and Co., Ltd., of Leonard-street, London. It involved the transport of 400 tons of material from one warehouse to another and was accomplished in four days.

The container system hardly needs description, but it is noteworthy that while it was introduced as recently as in 1925, when the L.M.S. had only twenty-five containers, that company now owns 3500. They are of both the open and covered types and of various capacities. They do not require special rolling stock, as they are

LOADING A CONTAINER ON TO A TRUCK

generally roped down in place in an ordinary truck so that normal traffic is not interfered with. The containers are, naturally, chosen so that they suit the loading and unloading facilities at the termini and the materials being conveyed.

For Messrs. Churchill's move, 150 of the D type containers were chosen. That type is of both open and closed form, and is of 4 tons nominal capacity. It measures 13ft. 3in. by 6ft. and is 3ft. high. A number of the same class of containers, but with roofs, were also used on the job.

The consignment comprised 20,000 different items pigeon-holed in steel racks, and many of these were taken out bodily and carted from the company's Salford warehouse to the Manchester goods depôt of the L.M.S. This work was done on the Friday and Saturday before Bank Holiday. Three special trains were made up for the journey to St. Pancras, and on arrival the trucks were put in a siding, so that the containers could be delivered when the streets were quiet.

Delivery was made by road from St. Pancras on Sunday and Monday, and by the use of a new 6-ton petrol-electric mobile crane the containers were delivered right into the building itself in positions most convenient for unloading.

It is a striking testimonial to the convenience of the container system of handling traffic that Messrs. Churchill were able to resume the service of their customers immediately after the holiday, so that no business was lost through the move.

THE Forests Products Research Laboratory, Princes Risborough, Bucks., requires a large supply of untreated timber, containing living insects, for the purpose of its investigations into the biology of the death-watch beetle. Architects, builders, and others concerned in the repair of buildings attacked by the beetle are requested to communicate with the Director, Forest Products Research Laboratory, Princes Risborough, Bucks., so that arrangements may be made for suitable material to be sent to the laboratory.

Railway and Road Matters.

THE new Ministry contains two directors of the Southern Railway—Major the Hon. Oliver Stanley, who is the Parliamentary Under-Secretary for the Home Office, and Sir E. Hilton Young, who takes the Department of Overseas Trade and the Export Credits Guarantee Department. The new Minister of Transport is Mr. P. J. Pybus.

THE annual report on railway accidents for the year 1930 has now been issued as a Stationery Office publication, price 9d. It is in a new form—not in size, but in contents—as it contains the final returns of accidents and casualties hitherto furnished in the annual accident returns. The latter now has only preliminary figures. The report is numbered Cmd. 3939.

THE winter train services come into operation on September 14th, except on the Southern, where the changes will be made on the 20th. The London, Midland and Scottish announcement of the trains to be withdrawn contains a new feature, in that it intimates that certain trains will be "reinstated on June 25th, 1932." The summer services were a week later in starting this year and, except on the Southern, cease a week earlier than in 1930.

THE Simla correspondent of *The Times*, cabling under date August 24th, says in relation to the falling off in traffic on the Indian railways that the later months of the financial year will probably show a less unfavourable comparison, and ruthless retrenchment will substantially reduce working costs, but it is almost certain that the State railways will not this year earn enough to provide for a contribution being made to the general revenues. The reserve accumulated in prosperous years for this purpose has in the last two years been almost exhausted.

THE Mirfield widening of the London, Midland and Scottish Railway and the same company's line between Barking and Upminster are to be provided with a type of colour light signal which, though not new, has suddenly become popular. Hitherto each of the three aspects, red or yellow or green, of a signal has needed its own lens and lamp. The searchlight signal, as it is known, carries behind a common lens a frame in which are the three colours, each of which is illuminated as required by the frame being attracted from the normal—red—position to yellow on one side and to green on the other. Its advantage lies in the less vertical space required.

ALL the eighty installations of automatic train control on the railways of the United States ordered by the Interstate Commerce Commission have been completed, and thirty of them finally approved. The equipment installed covers 15,194 track miles on 8387 route miles and 8874 locomotives. In addition to the work done under the requirements of the Commission, certain companies have voluntarily equipped 5188 track miles on a further 3135 route miles and 327 locomotives. During the year ended June 30th, 1930, the equipped locomotives made 2,330,402 trips over A.T.C. territory, which covered 176,077,792 miles and responded to 178,065,779 signal indications.

IN this column of our issue of August 23rd, 1929, we reported that a train had run into a motor car, which had burst through the level crossing gates at Hoghton, on the Preston and Blackburn line of the London, Midland and Scottish Railway, and fouled the running line. The result was that the engine of the train was so damaged that it could not continue its journey, and some of the wheels of the first coach were derailed. There has now been another accident at Hoghton from the same cause—on Tuesday, September 1st—but whilst there was no damage on this occasion to the train, a passenger in the motor car was killed. At the inquest on the following Thursday, the signalman admitted that a number of vehicles, including a charabanc, had crashed through the gates this year. We would add that quite recently we saw the announcement that this level crossing is one of those that are to be replaced by an overbridge.

THE Board of Trade export tables for July show that the value of the railway material sent overseas during the first seven months of the present year was as follows; the corresponding figures for 1930 and 1929 are added in parenthesis: — Locomotives, £1,064,160 (£2,158,244, £1,807,272); rails, £589,708 (£1,528,577, £1,627,949); carriages, £861,695 (£988,532, £1,286,720); wagons, £801,393 (£1,905,552, £1,517,721); wheels and axles, £128,312 (£206,175, £254,647); tires and axles, £189,942 (£409,463, £305,147); chairs and metal sleepers, £244,076 (£487,928, £293,256); total permanent way, £1,442,096 (£3,236,688, £3,207,643). The weight of the rails exported was 70,151 tons (175,090 tons, 195,531 tons), and of the chairs and metal sleepers, 32,488 tons (52,407 tons, 29,144 tons). During the month of July last the value of the locomotives shipped was £63,863 and included:—Straits Settlements, £13,388; Argentine, £9889; other countries in South America than the Argentine, £4819; India, £1980. During the same month the rails were of the value of £57,138, and included:—South Africa, £22,578; New Zealand, £8764; British West Africa, £7404; Argentina, £5690; India, £3627; Portuguese West Africa, £3280.

THE Ministry of Transport railway statistics for June have now been issued as a Stationery Office publication, price 2s. 6d. In any comparison with the corresponding figures for June, 1930, it must be remembered that Whitweek fell in the latter period, but was in May this year. The number of passenger journeys, compared with June, 1930, fell by 8·5 per cent., and of the decrease of 9,236,468 those at reduced fares numbered 6,735,640. The receipts from passengers were consequently down by 17·5 per cent. Unfortunately, the passenger train mileage was reduced by only 1·0 per cent. There was, however, a very gratifying change in the goods business done, which however, must be attributed to the incidence of the Whitweek stoppage being in June last year. The May, 1931, statistics were reviewed in this column of our issue of August 14th and showed a drop of 20·1 per cent. in tonnage and of 18·6 per cent. in goods traffic receipts. Now, June, 1931, shows a fall of only 0·1 per cent. in tonnage and an increase of 1·6 per cent. in the receipts. Goods train mileage was 3·1 per cent. more; the average train load increased from 120¾ tons to 122¾ tons, and the net ton-miles per engine hour—*i.e.*, the speed movement—from 440¾ to 453¾.

Notes and Memoranda.

ATTENTION is drawn by H.M. Consul at Harbin to the necessity for the passports of travellers going by the Trans-Siberian Railway having a Chinese *visa*.

IT has been estimated by the Canadian Department of the Interior that one horse-power produced by water power is equivalent to the saving of 5½ tons of coal per annum.

A NEW altitude indicator for showing height above the ground immediately below, not merely above sea level, is said to have been evolved by an Austrian engineer. From reports so far received it appears to depend for its action on gravitational attraction.

SINCE its establishment about two years ago the helium plant of the United States Government at Amarillo, Texas, has produced 22 million cubic feet of that gas, and the cost of production has been brought down from 11·47 to 5·95 dollars per 1000 cubic feet.

THE Aeronautics Branch of the United States Government is said to have discovered a material for lining petrol tanks which may render them much more safe in the case of accident. The material has many of the qualities of rubber, but is insoluble in petrol or oil.

THE Forest Products Laboratory of the United States has been investigating the strength of wooden columns built up of boards nailed together in various arrangements, and has come to the conclusion that it is possible to obtain a strength of from 75 to 90 per cent. of that of a solid column, while the scheme has the advantage that cheaper scantlings can be used.

SINCE the earliest use of poles for electrical distribution, the slow and expensive process of hand shaving has been the only means of removing the bark. For two years the Portland (Ore.) General Electric Company, states our American contemporary, the *Electrical World*, has been using a pole-shaving machine with entirely satisfactory results. With this air-operated tool one man can shave from eight to ten 50ft. poles in one day, easily doing the work of four men. Moreover, machine work is superior to the work done by hand shaving. Repairs are low and are confined almost entirely to making and sharpening bits. Experience shows that frequent changing of bits is advisable, two changes being made for each pole.

DURING the first six months of the current year the value of imports of electrical machinery and apparatus into Holland was £2,287,498, as compared with £2,931,914 in the first half of 1930. The principal item was radio, telegraph and telephone apparatus, which fell in value from £777,250 to £589,833. Electrical machinery imports declined in value from £367,166 to £310,916. The share of the leading supplier, Germany, declined, but that of Great Britain, which occupies second place, experienced a slight increase. Dutch exports during the first half of this year were valued at £3,138,416, against £4,241,166 in January–June, 1930. In this section, too, radio, telegraph, and telephone apparatus was the chief item, accounting for £2,064,583 of the total, as compared with £2,608,916 in 1930. The value of exported incandescent lamps declined from £848,166 to £636,500, and that of wires and cables from £197,084 to £141,750.

A POWER station which utilises peat for fuel is operating at a distance of 75 miles from Moscow. It is called the Shaturs power station, is situated near three small lakes lying close together, and adjoins an immense peat bog. The present operations cover about 50 square miles. There are, according to the *Electrical Times*, three large boiler-houses fitted with chain grate stokers specially adapted for burning peat. The turf is supplied in two forms, sods and dust, the dust dropping on the top of the sods in the furnace. The latest boiler put in is made to burn turf dust only. It has a number of oil burners to heat up the furnace before commencing, but has no chain grate. The present way of collecting the turf is by means of powerful hydraulic hose jets which play on the turf and wash it down into an excavated pit as a wet sludge. It is pumped out of this on to the fields, where it is left to dry. Then a slicer on a caterpillar tractor runs over the field, cutting the turf into sods and turning it over.

PHOTO-CELL control has been applied to nine street-lighting circuits in North Albany, N.Y., and it has been reported by the New York Power and Light Corporation that all of the seventy-five circuits in Albany will ultimately be operated in a similar manner. Plans are also under way to apply the system in Schenectady, Troy, and other districts served by this company. As soon as a predetermined degree of darkness prevails, regardless of time of day or season, the photo-cell actuates a relay, which in turn operates the switch controlling the street lights. When natural light is sufficiently restored the reverse operation occurs. The photo-cell is mounted on the roof of a building, and the "eye" is directed toward the north, so that it may receive average light and not direct sunlight. A thermal time-delay relay prevents instantaneous operation or fluttering of the street-lighting control in response to disturbances, such as the passage of a cloud over the sun, a flash of lightning at night, a person walking in front of the unit, &c.

A STEEL plate mill, which is claimed to be the largest in the world, has just been completed by the United Engineering and Foundry Company, Pittsburgh, for the Illinois Steel Company, South Chicago, Ill. Motors approximateing 30,000 H.P. will drive the mill, and the plates will be manipulated entirely by mechanical means. Plates up to 92in. wide can be rolled continuously in lengths up to 140ft. at a delivery speed varying from 350ft. to 700ft. per minute. The total length of the mill from the soaking pits to the finishing end is 2100ft., or more than one-third of a mile. The vertical edging mill, a component part, is understood, says *Steel*, to be the largest ever built and the gear drive for the roughing stand probably is the largest yet attempted. The latter has two gears 21ft. 8in. diameter with teeth 6ft. wide across the face. Continuous operation is carried out to the maximum degree. The entire mill will be under electric control, both for controlling the thickness of plate and operation of side guides and looping apparatus. The driving motors are of the variable-speed type.

Miscellanea.

THE Wakefield Corporation has decided to substitute motor omnibuses for the tramways.

THE Swansea Council proposes to expend £2,096,000 on electricity and main drainage schemes.

THE keel of H.M.S. "Falmouth," a sloop of 1500 tons, has been laid down in Devonport Dockyard.

A FLOW of 2000 gallons of oil an hour has been obtained from the Moturoa well at New Plymouth, New Zealand.

A NEW radio station of 20-kW capacity is to be erected at Maracay, Venezuela, by the Telefunken Company, of Berlin.

A NEW plant for the creosoting of timber and poles by the pressure process is to be put up at St. Lambert, Quebec, at a cost of 200,000 dollars.

A DEPOSIT of amorphous graphite has been discovered near Glendale, Inverness County, Nova Scotia. It is said to range from 50ft. to 100ft. in width.

THE Lincoln City Council proposes to expend £100,000 on the reconstruction of its gasworks. The new plant is to have a capacity of 3,000,000 cubic feet of gas a day.

THE hydro-electric power scheme on the Ouree River, in Nigeria, which will enable the whole of the tin-mining industry of the district to be electrified, is very nearly completed.

WORK has been started on the improvement of the French port of La Rochelle-Palin, to enable it to accommodate the largest Atlantic liners. The work will occupy seven years.

A GUIDING sign for airmen, of the type recommended by the Civil Aviation Section of the London Chamber of Commerce, is to be laid down at Norwich. It will occupy a strip of land 278ft. in length.

THE Ford Motor Company is about to put up a new factory in Mexico for the assembly of motor cars. The output is to be 100 cars a day, and the cost is put at three million pesos. About 1000 hands will be employed.

IT is proposed to build a new bridge over the river Riachuelo to improve the traffic facilities between the city and the province of Buenos Aires. The bridge will be 170 m. long by 24 m. wide, and is expected to cost three million dollars.

PROGRESS in the construction of the great maritime port of Haifa, on the coast of Palestine, will make it possible for Imperial Airways to introduce, experimentally, a faster and more direct winter air service between Britain and India, which will cut out the stop at Alexandria and reduce the length of the journey to Karachi to less than six days.

FOR the convenience of motorists from the Provinces, the Automobile Association has published a booklet which contains information of the garage accommodation available near selected railway stations encircling Greater London. The address, telephone number, and particulars of the facilities available are included, in addition to a plan showing the position of each garage in relation to the railway station to which it is adjacent. Copies of the booklet may be obtained by members free, on application to the Association.

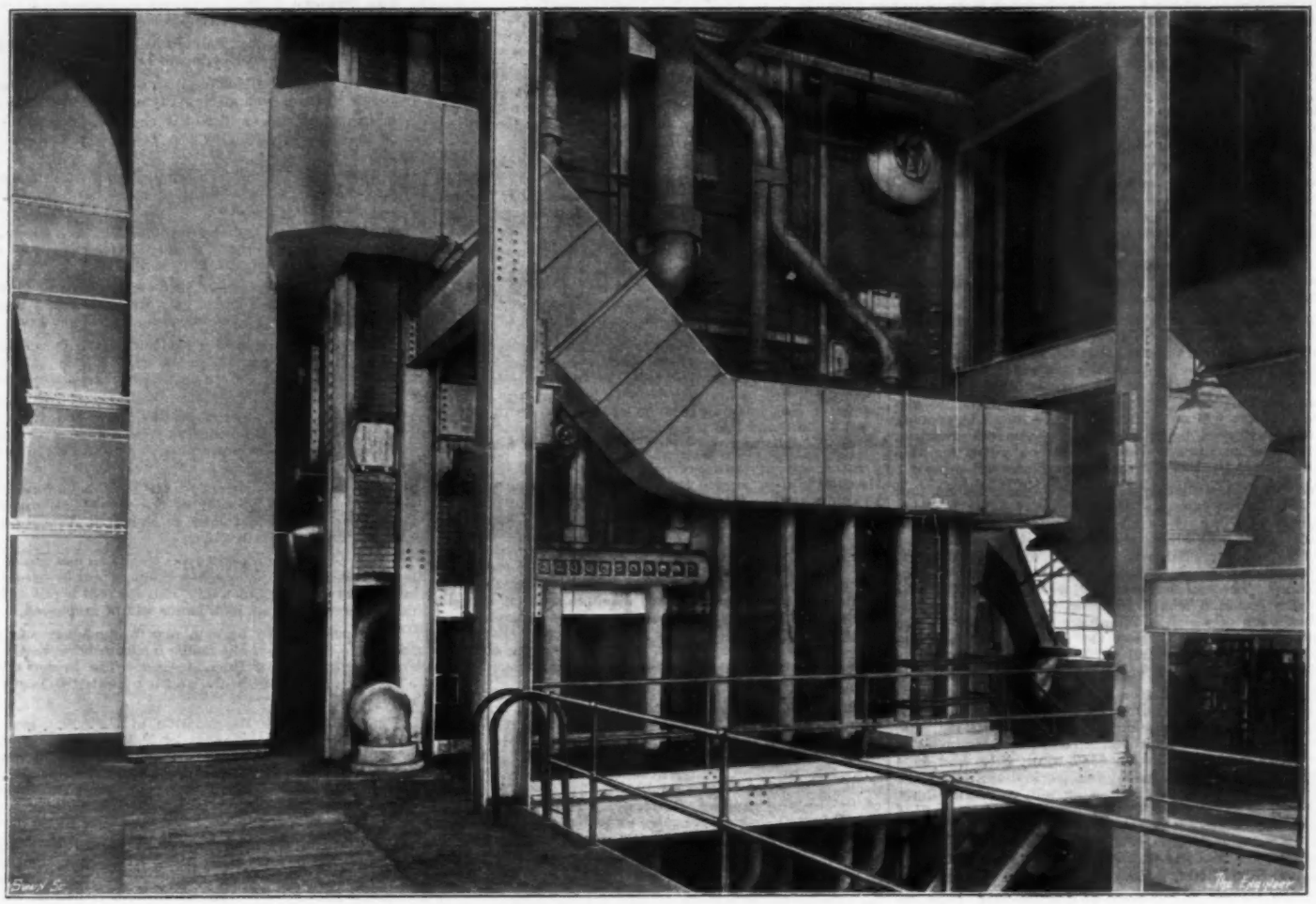
THE production of pig iron in France during July amounted to 680,000 tons, as compared with 861,000 tons in the corresponding month of last year. The number of furnaces in blast was 115, instead of 147. The quantity of raw steel produced in July last was 650,000 tons, against 790,000 tons in July, 1930. There was a notable decline in all descriptions of rolled iron and steel, except joists. Compared with July of last year, bars fell from 209,000 tons to 187,000 tons. Rails and sleepers declined by more than one-half.

A PROPOSAL by Sir Murdoch Macdonald and Partners, of Tidal Energy, Ltd., London, for the construction of a dam across the mouth of the Tresillian River at Malpas, has been placed in outline before the River Committee of the Truro City Council, which has asked for details of the scheme in writing. The object of the promoters is to prove the merits of generating electricity by tidal energy, and they are said to be prepared with that end in view to expend between £20,000 and £30,000 on an experimental generating station. The suggestion is to construct a dam across the river at the Malpas end, with lock gates for pleasure steamers and other river craft, and to erect over the dam a bridge for vehicular and pedestrian traffic, thereby connecting Malpas with St. Michael Penkivel at that part of the Fal.

AN extensive bridge-building programme, which includes two very important structures, has been announced by the Quebec Government, and contracts for three of the smaller bridges have already been awarded. Plans and specifications for all of the bridges to be built have been approved by the Provincial Department of Public Works, and work will commence as soon as the contracts are awarded. The building of the bridges, which will involve an expenditure of approximately 7,500,000 dollars, will do much to facilitate communications in various parts of the province. A bridge connecting the north shore of the St. Lawrence River, near Quebec, with the Island of Orleans, and the Caughnawaga bridge across the St. Lawrence, adjacent to Lachine, near Montreal, are the two structures of paramount importance to be erected, and tenders for both will be received shortly. Each of these bridges, it is estimated, will involve an expenditure of well over 2,000,000 dollars. The bridge from the mainland to the Island of Orleans will cross the north channel of the St. Lawrence, and connect St. Gregoire with Ste. Petronville, near the south-western tip of the island. Contract awards have already been made for a bridge, 1932ft. long, over the St. Francis River, between St. Francis du Lac and Pierreville; a bridge 890ft. long, over the Richelieu River, between Sorel and St. Joseph de Sorel; and for the substructure and superstructure of a bridge, 992ft. long over the Yamaska River, between Yamaska and Yamaska East. All three bridges are to be of steel and concrete construction, and work will start immediately.

GATINEAU PAPER MILL—BOILER-HOUSE

(For description see page 274.)



SIDE VIEW OF BOILER WITH AIR-HEATER ON THE LEFT

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ONE SIXTEEN-PAGE AND ONE FOUR-PAGE SUPPLEMENT—THE SHIPPING, ENGINEERING AND MACHINERY EXHIBITION AT OLYMPIA.

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THE ENGINEER.

VOL. CLII. No. 3948

SEPTEMBER 11, 1931.

Salaries.

WE have often observed that American engineers seem really to enjoy composing, answering, and analysing questionnaires. Sometimes they are of a purely technical kind and result in reports which indicate the trend of engineering in the United States. Sometimes they are of a social or even personal kind, like one which lies before us as we write. The value of such inquiries is directly proportional to the number of people who provide data. In this country questionnaires are regarded as an impertinence; they are only tolerated under the pressure of authority, and voluntary response is never sufficiently large to be truly representative. Take the case before us. It is an inquiry into the earnings of professional mechanical engineers in 1930. Anyone who asks an Englishman to say what his salary is may be expected to be told to mind his own business. Not so in the United States. A Committee on the Economic Status of the Engineer, of the American Society of Mechanical Engineers, received replies to its questions from nearly ten thousand members, or over 50 per cent. of the membership. What particular purpose the inquiry is to serve we do not know; it was probably nothing more than doubt upon that point which caused the other 50 per cent. of the members to put the questionnaires in the back of the fire. We do not think any of them would have felt such resentment at prying into their private concerns as would have led 99 per cent. of English engineers to follow the same course, and to leave all the answering to those who are always ready to proclaim that they are grossly underpaid.

But whether there is any substantial value in such returns, they are undoubtedly of very human interest, and we imagine that the September issue of *Mechanical Engineering*, in which they are analysed, will be scrutinised all over America by middle-aged engineers to see how their salaries compare with the "medians," and by young engineers to see what prospects the future holds out to them. It may be taken, on the whole, that salaries in America are rather higher than here owing to the lower purchasing value of money, but it is not unlikely that the relationship between earnings at different ages and in different occupations is fairly constant. It is probable, too, that the Committee's comments on certain aspects may apply here as well as there. Hence a few words about the report should prove acceptable. The figures are based on the salaries of 1930, before the depression led to "cuts"; they refer to professional incomes only and exclude "unearned" incomes; they represent not average, but "median" earnings. To get the medians the salaries in any given classification are arranged in order of size. The total number of entries in the classification is then counted, and the salary of the man who comes in the middle of all the men in the classification is then taken as the "median" of the classification. This course was obviously necessary to prevent the exceptional salaries of men at the top inflating the average of the typical man. Bearing these explanations in mind, we may glance at a few of the returns. Taking all classifications, it appears that on leaving college, at the age of 23–24 years, the American engineering student may expect a salary of about 2000 dollars—say, £400 per year. About 10 per cent. will rise by increments that are nearly constant till at the age of 60 years their salaries reach £5000; whilst 25 per cent. may expect to rise fairly rapidly to £1800 and more slowly to £2500 at 55 years. After the ages mentioned a slow fall takes place. A question of great interest is the value of technical education. A curve shows that for the first five or six years of business life technical qualifications do not make much difference to salaries, but between the ages of 35 and 40 the exceptional man—B.S. Plus—secures a sharp rise to £1300, whilst the man with an ordinary B.S. degree climbs steadily by regular increments until he is in receipt of £1400 a year at 45. Further rises take place more slowly, but at about 60 the ordinary B.S. man passes the superior man, whose value, for some reason not so far explained, begins to fall off at that age. Now let us look at those who fail to graduate and those who are non-technical. The former reaches the level of the "plus" men at 45, then drops behind a bit, but at 55 is worth as much as they, and continues to rise whilst they are falling, reaching the summit of £1600 at 60. The non-technical man lags behind all the others till the age of 50, when, for five years, he rises steadily to £1500. A curious point is that even worse than the non-technical man is the one with evening class education, whose highest earning is £1400 at 55. In this connection the Committee points out that the return may be deceptive because, whilst the engineers with evening class education are almost certain to join the Society, the non-technical man does not do so until he has achieved success. It may be anticipated that returns from our own institutions in which a severe test of fitness for membership is insisted upon, the result would be different. We have not the space to examine all the returns, but one other must be mentioned. It shows very clearly that "general management" has much more financial value than any form of technology or science. Any member of the Society who has powers of organisation and control may expect a salary of £2000 at 45 and after the age of 60 should receive £2400. The consultant does not do nearly so well, whilst the designer, the teacher and the "technical operator" never earn more than half that of the manager, and the "buyer and seller" is not very much better off.

Assuming that the figures obtained by the American Society of Mechanical Engineers are really representative and that the method of presentation gives a true picture; assuming also that what occurs in America will occur here, we may ask what conclusion may be safely drawn from the report? There is, as far as we can see, only one beyond all question. It is that industry is prepared to pay most to the engineer who can manage affairs and men. The Committee is so struck with this conclusion that it suggests that engineering schools should bend their curricula somewhat towards that end. We have little doubt that such a course would result in disappointment. Colleges might teach, and already do teach, the mechanism of management. Anyone can learn that, and, if we may judge by the flood of literature, anyone can write about it. But the men who get the big salaries are not those who handle problems of management by text-book methods. They are men with particular qualities and personalities, and we doubt very greatly that they can be made by education. They are more likely to develop upon the basis of a general and technical education than to be produced by special curricula. The only other salient fact is that a good education is worth while, yet it must be noticed that though he may have to wait a little longer, the non-technically educated man in engineering industries may attain

to a level with the B.S. It all depends upon his executive power, for, after all is said and done, it is that which wins the big salaries. Scientists may rebel against that fact; they may claim that knowledge is worth as much as business capacity; that it ought to be paid much more than it now receives, because it is at the root of all advance. They may say what they please, but Business will continue to pay the highest salaries to those who can conduct industries. It will nearly always give more to the man who can, let us say, organise the production of electric lamps for the million than to the man who invents improvements in them.

Electrical Accidents.

WHEN it is remembered that the voltage applied to factory wiring, and even that of private houses, is far from harmless, the number of accidents that occur each year cannot be regarded as excessive. Considering the many people who now handle electrical machines and appliances, and that under certain conditions shocks received from ordinary supply circuits may prove fatal, the number of fatalities is really small. To eliminate accidents entirely is scarcely within the range of possibility, but it is satisfactory to learn from the recently issued report of the Senior Electrical Inspector of Factories for the year 1930 that, although the number is not decreasing, the rate of increase is small in relation to the greatly increased use of electricity.

Acting on the suggestion of Mr. Scott Ram, who has now retired, the present Inspector, Mr. H. W. Swann, has tabulated his figures on five years averages, which show that for the years 1920–24 inclusive the average number of accidents was 364, and for the period 1925–29 394. As the Electricity Commissioners' reports show that from 1922-29 the number of units sold increased from 3645 to 8597 millions, these figures, as far as they go, cannot be regarded as bad. Of the 359 accidents covered by the present report, 21 were fatal, whilst of 34 other accidents which proved on investigation to be non-reportable, 10 were fatal. Forty-six other accidents which occurred in places other than factories came unofficially to the knowledge of the Department, and of these 15 occurred on domestic premises. No fewer than 110 accidents were met with on switchgear operating at pressures below 650 volts, but only one proved fatal. No other class of apparatus was responsible for so many accidents as that under this heading, which covers such things as switchboards, fuse gear, and motor control apparatus. The failure of the insulation of cables and flexibles was also the cause of considerable injury; in fact, next to switchgear, cables and flexibles were responsible for the greatest number of accidents. Sixty-four persons were injured and two were killed, and, as in other cases, severe burning of the victim was frequently recorded. Although extensive use is made of tough rubber, failures occur, owing mainly to misusage, or the absence of effective sheath grips, a matter which would seem to demand the attention of the guardians of safety. Notwithstanding the attention that has recently been paid to the protection of screw lamp holders, which are frequently used in places were lamps are liable to be stolen, there were six fatal screw lamp holder accidents coming within the scope of the report, whilst another accident of the same nature is mentioned. As is well known, it is an easy matter to connect these lamp holders incorrectly, so that the screw of the lamp is "live" to earth, and although skirted lamp holders and separate skirts which can be applied to existing holders have been introduced to protect the screw and are specified in the Home Office regulations, the unprotected type of holder appears to remain in use. But while protection of this nature is undoubtedly desirable, the Inspector points out that in connection with certain work—as, for example, the construction of buildings—portable lamps are often subjected to very rough usage, whilst frequent alterations to the wiring may also impair safety. Long ago we suggested, when considering portable lamp accidents, that there would sometimes appear to be a good case for reducing the pressure by means of transformers, and we note with interest that Mr. Swann has come to the same conclusion. By far the greatest number of fatalities occurred on 250/200 single-phase circuits. Twelve people lost their lives in places provided with this class of supply, whilst only one fatality was caused by D.C., being brought about by a defective 500-volt circuit breaker igniting a quantity of petrol which had been used to clean it. Three-phase, 440/400-volt, 20,000 and 33,000-volt systems were responsible for four, one, and two fatalities respectively, whilst a 2650 single-phase supply caused one fatal accident, making twenty-one fatalities in all for the establishments covered in the report. Mainly in consequence of the fact that electricians frequently work on apparatus whilst it is alive, they are usually the most unfortunate as regards accidents. Contrary to what might be supposed, many fail to appreciate the danger of low voltages. The effects of a shock are, of course, largely dependent on the conditions under which it is received, and electrical workers who get one or two slight shocks are apt to under-estimate the results of, say, a 230-volt A.C. shock, received in really good style. The best thing that can happen to an electrician is for him to get a fairly good, but not really dangerous, shock early in his career, for it will make him realise what he is dealing with and cause him to be careful for the remainder of his life.

In this country, where manufacturers and contractors usually take great pains to secure safety, there is little objection in these days to 230-volt A.C. for general lighting and domestic purposes, but on certain parts of the Continent the state of affairs is somewhat different. Dealing with the statistics of the Royal Swedish Inspection Board, in their book on Rural Electrification, published last year, Dr. Alfred Ekstrom and Vidar Ekstrom state that for more than a decade there has been a very animated discussion in electrical circles as to whether 110 or 220 volts A.C. is preferable for electric lamps and domestic purposes. Those who view the matter from the economic point of view consider that the increased danger of 220 volts, as compared with 110 volts, is insufficient to warrant the extra expense which the low pressure involves, whilst the "safety first" advocates oppose this view. As might be supposed, statistics show that there are many more fatal accidents on the 220-volt systems than there are on the 110-volt systems. During the last five years the number of fatalities in places served with A.C. at the lower pressure was approximately one per annum per million people, whilst the corresponding figure for the higher voltage supplies was eight, notwithstanding that the latter pressure is used less extensively than the former. The greater danger of the higher voltage has been exemplified on the Continent during recent years by the more extensive use of electricity for household and farming purposes, but a point to be kept in mind is that in all probability finality in the design of equipment has not been reached. Possibly the number of 220-volt accidents could be reduced by improvements in distribution, house wiring, and fittings, or where the conditions are exceptionally arduous and liable to result in damage to fittings, &c., by the use of local transformers.

Present-Day Ship Propulsion.*

By F. E. REBBECK.

AT the present time there is, as you know, an enormous tonnage laid up throughout the world, and one occasionally hears the opinion expressed that there will be little new tonnage constructed until all of this laid-up tonnage is in service. But some of this was already so old when it was laid up, and has been lying up for so long, that it is now out of date in many respects—insufficient speed to meet modern ideas, poor equipment for handling cargo, propelling installations that are veritable fuel eaters, and generally unsuitable to go on the high seas and compete with modern tonnage.

With so much tonnage laid up, and practically no building proceeding in this country, it is a serious thought that foreign countries are steadily building very modern ships which will be a real menace, not only to the laid-up tonnage when it comes once more into the open, even allowing for its written-down value, but to new tonnage not equally modern and competitive.

This means that sooner or later—and perhaps sooner than some of us think—new tonnage will be required when trade begins to move; not because there are no ships available in this country, but because much more economical vessels will require to be used to compete with the modern tonnage of our foreign competitors.

For our purposes the mercantile tonnage of the world may be classified, roughly, into say five groups, viz.:—

(1) The tramp cargo vessel, say about 10 knots.
(2) The liner type of cargo vessel, say about 12–15 knots.
(3) The combined cargo and passenger vessel, say about 16–18 knots.
(4) The medium size, moderately fast passenger vessel, say about 19–23 knots.
(5) The large fast passenger vessel up to the largest constructed, say about 25 knots and upwards.

* Institute of Marine Engineers. Presidential address, September 8th, 1931.—Slightly abridged.

For the first group the general consensus of opinion amongst British shipowners would call for simple triple-expansion engines, with two or more cylindrical boilers, with the minimum amount of auxiliary equipment. Having regard to the rough nature of the service, also the fact that the owners of such vessels usually like to feel that their tonnage is saleable at any time in the widest market, it is possible to appreciate why this type of machinery installation is in general preferred; although it is to be observed that continental owners seem to prefer internal combustion engines almost to the exclusion of all other types of propelling machinery. For example, I think it is generally admitted that Norwegian tonnage can operate with a profit where the vessels of other nations find it impossible—and evidently they find that this can be done to the best advantage with the oil engine.

The steam reciprocator at present preferred in this country for tramp tonnage is very simple in construction and very cheap in first cost, two factors of prime importance to any shipowner when in doubt; but decisions regarding questions of policy do not permit of the matter being settled in this way.

There are not many vessels included in the fifth group. Consequently, the consideration that has to be given to the propelling equipment of these large fast vessels is generally confined to few owners and few builders, and naturally the responsibility in fixing the propelling units for such vessels is very considerable. Taking the world over, the consensus of opinion for this class of vessel is at the moment, I believe, unquestionably in favour of high-pressure, high-temperature steam installations, consisting of water-tube boilers and geared turbines, with every conceivable refinement which would make for increased economy. To realise the maximum in this direction, the electric generating units should be driven by oil engines. There are a few who in the interests of still further economy would propose Diesel-electric propulsion for this type of vessel, and some who would adopt a turbo-electric system of propulsion, but neither of these would represent the opinion of the majority of authorities on the subject, who for this fifth group would certainly specify a geared turbine installation, as already indicated.

For the vessels included in the three middle groups—(2), (3), and (4)—which together constitute such a large proportion of the world's tonnage, any well-recognised system of propulsion is technically practicable; and the problem facing the shipowner is to decide what is commercially best for him in his own individual circumstances. Full consideration has to take into account the first cost, weight, space, insurance, depreciation, operating cost, upkeep, &c.; and it is only after a very careful examination of all these factors that an answer can be given to the question of what is the best commercial proposition for any particular ship or service. If it were only a matter of arithmetical investigation, the answer would not be so difficult to arrive at; but there is much more in it than this. The problem calls for expert judgment, the result of wide and long experience, as what may be suitable for one particular service may be out of place for another. A complicating factor for the shipowner is inevitably the conscious or unconscious bias of each engineer whom he consults. In other words, upon a technical problem there is superimposed a psychological one. The consequence is that the values assigned to the various factors are liable to be so very different, depending on the point of view, experience and temperament of each engineer evaluating them, that the conclusions deduced are in their turn extraordinarily divergent. It is here that the shipowner naturally becomes perplexed. To him it seems a case of doctors disagreeing; and it is therefore not to be wondered at that when this occurs he ends the consideration of the subject by buying whatever is cheapest in first cost, and thus makes his financial risk as small as possible.

The people best able to say which system of propulsion pays them best should be the shipowners themselves, providing their judgment is founded on actual running experience of a number of comparable vessels fitted with the different types of machinery, over a representative period of time—the longer the better—and when all the factors to which I have referred have been brought into the balance sheet on which their decision is based.

The question of first cost generally settles itself, as far as the owner is concerned, by means of a tender. As regards what the machinery will do in service, the tender only applies to the extent that promises can be considered as acceptable, and it is in this connection that the question of co-operation between builders and owners comes in.

It must not be inferred that I consider there has been no collaboration in the past. On the contrary, the degree of co-operation between shipowners and shipbuilders has been as close as anything to be found in other spheres of industrial activity. But during the last decade the need of even closer co-operation has impressed itself upon me very strongly, and the present stagnation in trade has emphasised the necessity of this co-operation being developed to an extent that was not felt to be necessary in the days when this

country built and owned by far the greater proportion of the world's shipping. With Great Britain's percentage falling, as it is, this closer co-operation between British shipowners and British shipbuilders is not only desirable but vital.

In considering the possibilities associated with marine engineering developments, I would stress the necessity for patience, and for the continuation of co-operation after any new kind of machinery has been placed in service. The engineers responsible for any phase of development or for the design and manufacture of any particular type of machinery should be given the fullest information, over a reasonable period of time, regarding its performance. The members of this Institute will be very conscious of the extent to which the success in service, particularly during the first one or two years of the vessel's life, depends on the extent to which the operating engineers on board apply themselves to the new conditions. In my opinion, if that success is to be ensured, the part which the owner's superintendent and the ship's engineers have to play is one of equal responsibility to that of the designer or the constructor. And future developments must call for even greater co-operation between the operating engineer and the builders than ever before, for as we go out to meet the intensified competition of our foreign rivals our own endeavour must carry with it a more intensified effort, and compel us to adopt what the engineer dislikes so much, viz., higher and still higher machinery ratings, although we must not carry this to the extent of incurring any undue or unreasonable risk. We cannot remain in the comfortable position that we held before so many keen rivals entered the field to increase the pace.

A point that must give us some concern as a coal-producing nation is that while all these systems of propulsion are being developed, we are more and more having to go over to oil fuel, to the detriment of our coalfields. Investigations in connection with the use of pulverised coal, and more important still, research into the subject of oil extraction from coal along the lines of the hydrogenation process, while receiving a considerable amount of attention, must be given more vigorous support if sufficiently rapid progress is to be made to reduce the present menace to our coalfields. While a certain amount of progress has been made in the utilisation of pulverised coal, it is difficult to see how this can become a serious competitor with coal utilised in the form of oil. The application of oil fuel has now gone so far that there can be no turning back ; and there seems no prospect of recalling success to the coalfields unless, as stated, the hydrogenation process or something equivalent is developed in different centres of the country on a very big scale. As already indicated, the problem has been appreciated to some degree, but the results to date are infinitesimal compared with the magnitude of the position consequent on the ease with which oil fuel from overseas can be obtained, and the low prices that are now ruling.

The general adoption of oil fuel is, of course, the fact that accounts for a great deal of the latter-day development in ships' propelling installations. It is this more than anything else that is responsible for the extent to which the water-tube boiler is now used, paving the way to the higher pressures now available. Furthermore, present-day methods of gear-cutting have enabled the high-revolution turbine to be developed. And in the very low fuel consumption figures now obtainable, we have the result of both of these. It is oil fuel also that has given us the alternative method of propelling ships by internal combustion engines.

While the success of modern air and land transport was assisted to a great extent by the wide public interest shown in the internal combustion engine for these services, it cannot be said that anything comparable happened to forward its development for marine purposes. The phenomenal progress that it has made, therefore, has not been the result of its popularity, but rather its inherent capacity for producing low running costs. It had to contend with the fact that it was an expensive machine to produce, and was therefore handicapped by a relatively high first cost. But it has now reached the stage of development where its capital cost on a horse-power basis is very materially reduced ; in fact, for the higher-class vessels it can be produced at approximately the same capital cost as other systems of propulsion using steam.

The proper and natural place for each of the different systems of propulsion will in due course be determined by the extent to which in the passing years they can meet owners' service requirements to the best advantage.

While it is true that considerable improvements in power or economy can be realised in existing installations in various ways, such as by the introduction of exhaust turbines applied either through the medium of gearing or by electrical transmission, or by the adoption of one or other of the patent valve systems which can be incorporated in the high-pressure cylinders of reciprocating engines, these must nevertheless be looked upon rather as palliatives—very useful, but not likely to be regularly adopted in new installations in competition with other straightforward systems of propulsion.

The magnificent vessels that have been turned out during the last few years, and are being constructed at the present time, give evidence that very fine ships can be built with either steam or motor propulsion to give very economical results. They can be made equally free from vibration in either case ; also, there is very little difference in their first cost, and the relative running cost over the next few years of the steamers and motor ships recently turned out, and now under construction, should provide figures that will be the guide as to what extent in future shipowners will adopt one system or the other.

Literature.

A Monograph of Viscometry. By GUY BARR, B.A., D.Sc., Senior Assistant, National Physical Laboratory. Oxford University Press. Pp. 318 folio +xiv.

Of late years a renewed interest seems to have been taken in the scientific aspect of the mensuration of viscosity, which the author ascribes to new requirements created by the progress of aviation. In this country the demand for the general adoption of the use of absolute units was strongly put forward by Archbutt and Deeley in their book on lubricants some thirty years ago, and at least one other investigator referred to by them in the second edition of their book used a long vertical capillary and computation from theory for practical work. Archbutt and Deeley proposed calibration with glycerine solutions of known absolute viscosity applied to a simple form of pipette or burette viscometer, but the powers that were and are remained true to the arbitrary form of viscometer proposed by Redwood on the lines of Engler's German instrument. Now Dr. Barr has brought the matter forward again in a compilation of what is known about viscometry from a theoretical point of view in the fairly exhaustive memoir now under review.

To the physicist *ex professo* there is not much of startling novelty in the book, but it has the inestimable value of putting together the sources of error and the methods of computation necessary for arriving at extremely accurate results. Let us say at once that this extreme accuracy is never likely to be of great importance to engineers in the case of figures which quite often change by 1 per cent. with a fraction of 1 deg. Cent. It may, however, be essential to those who use various physical constants for identifying substances like oils and solid fats, &c. &c. This one-sided treatment of the subject, as confined to the art of mensuration alone, has, however, to the reviewer's way of thinking, carried the author a bit too far, as he has passed over Hyde's* research on the alteration of viscosity through high pressure with a mere mention—page 70—and Oelschlaeger's† attempt to express the temperature coefficient for the viscosity as a logarithmic relationship between viscosity and temperature is not mentioned at all. These matters have an enormous importance in practice, and they also form a sort of missing link in the theory of viscosity.

Roughly, half of the book is devoted to the flow of viscous liquids through capillary tubes. The discussion of the theory proceeds on strictly orthodox lines. After giving an extract from Newton's "Principia" in the original Latin, the author proceeds *vid* Coulomb, Navier, and Stokes to Poiseuille, whose empirical formula on experimental basis is laid as the basis of all the development of the theory of capillary flow, as usual. Hagenbach's theoretical deduction of the coefficient η follows as a matter of course, and this investigator's deductions relating to the correction for the kinetic energy of the moving column of liquid. This correction results, as is well known, in a diminution of the measured pressure by a certain amount to arrive at the effective pressure. Similarly, the "end effects" are reduced to additions to the length of the capillary. All these corrections can, however, be made very small by choosing capillaries of considerable length in ratio to the diameter, in which case the necessity for making the liquid flow into a wide tube or into a quantity of the same liquid, in which the end of the capillary is immersed, disappears. The difficulty of obtaining long capillaries of uniform bore has been overcome by the makers of late years, and tubes of, say, 500 mm. length and 1 mm. to 2 mm. diameter, are easier to clean than the very fine capillaries used by some investigators. It may be added that the formation of drops is not of any serious influence on results, besides which the average drop weight gives a more accurate value of the counter pressures by surface tension than the computed values for end effect, according to Couette and others, and is more easily arrived at. Hence it may be said that from a practical point of view, it is better to design a viscometer with small corrections for the values calculated from the dimensions than to make it such that variable corrections are necessary.

The chapter on tube viscometers for absolute measurements, and the estimation of their acting dimensions is an extension of the preceding chapters, and, like the remainder, mainly of interest to physicists. From that point of view it would have been interesting to have seen some optical method of determining the diameter of capillaries attempted. A mercury-filled capillary in homogeneous immersion behind an optically plane glass of the same refractive index would give a reflecting cylinder of mercury, the radius of curvature of which could be determined by letting a homogeneous beam of parallel light from a fine slit traverse the cylinder from a fixed position and observing the direction of the reflected beam in the two extreme positions of incidence. Many other ways of the kind are possible, and for very fine capillaries something more accurate is wanted than the electrical method mentioned. The corrections for conicality and elliptic section are well known from general physics, but even here an optical method might involve advantages over the tedious measurements of a short column of mercury in different positions.

Proceeding to the chapter on commercial absolute viscometers, it is questionable whether the Redwood, Saybolt and Engler viscometers can be classed as absolute. On the other hand, Barbey's "Ixomètre" seems to have some claim in that direction. The capillary in this case is replaced by a fairly wide tube—5 mm. bore—in which is inserted a concentric cylindrical rod—4 mm. diameter—fixed in a central position at both ends. The annular space between the two is the "capillary." This apparatus is worked upwards by a constant head of oil, and the oil issuing during a certain time passes through a side tube at the top into a measuring tube. Naturally, the velocity equation for this arrangement is different from the Poiseuille-Hagenbach expression, but otherwise there is no reason why this form of absolute viscometer should not be used in connection with absolute units. The practical advantages are many, easy cleaning, absence of slip, easily measured dimensions, &c., being the most obvious ones. In the practical form illustrated on page 103, the instrument is neat in appearance and undoubtedly easy to use. By a curious coincidence the reviewer has lately been using a similar arrangement for studying the flow of gases, and he has found that the rod, if allowed a modicum of play, centres itself, if the inlet is from the actual end of the 5 mm. tube, instead of from the side.

It would carry us too far to go into all the various forms of tube viscometers of the Ostwald type, &c.; hence it might be as well to put the rest as briefly as possible.

A chapter on the transpiration of gases is inserted, and is a welcome addition. This is, like the rest of the book, fairly orthodox, and nothing is mentioned about the flow of gases under high pressures and at high velocities, when viscosity becomes insignificant and the kinetic energy correction the main effect. To confine the attention to the conditions, when the effects are independent of density, may be in conformity with the scheme of a book on viscosity, but engineers are probably more interested in things like wind resistance at high speeds, ejector effects, air conveyor effects, &c. One might assume that investigations at the National Physical Laboratory would involve measurements of transpiration of gases under high pressures with correspondingly high velocities, but perhaps the results are not yet to be published, from reasons of advisability.

The following chapter on the falling sphere method for determining viscosity of liquids is perhaps the most up-to-date part of the book. In practice, the method is used to some extent for comparing the very high viscosities of cellulose sols for artificial silk manufacture where other methods are inapplicable. As giving rise to highly interesting theoretical considerations, this simple method is of fundamental importance, and the author has included the modern work by Oseen, Faxén, and Ladenburg, making the chapter worthy of the closest study.

The remainder of the book describes the oscillatory disc and cylinder methods, and a number of instruments based on various principles, keeping the reader interested to the end. An appendix giving the official specifications of the various industrial viscometers finishes the whole.

To do justice to a book like this is impossible in a short review, as there is so much of merit to point out, and really nothing to condemn, except what has come by tradition in the way of omissions and one-sidedness. It is no doubt the most complete and most carefully written book on viscometry in the English language which has appeared as yet. The danger to its popularity lies in its strictly academic form, but as the circle of readers with taste and knowledge to suit it is ever increasing, it is to be hoped that it will find a ready market.

* J. H. Hyde, "Report of the Lubricants and Lubrication Inquiry Committee," London, 1920.

† E. Oelschlaeger, "*Die Zähigkeit von Oelen*," Zritsche. d. Ver. Deutsch. Ing. 62, 1918, p. 422, &c.

THE INSTITUTE OF METALS.—On Sunday next over 200 members of the Institute of Metals begin their annual Autumn Meeting in Zürich. A party of 100 British members leaves London on Saturday for the Conference, which will be attended also by more than 100 foreign members from fifteen different countries. This cosmopolitan gathering, to be presided over by Dr. Richard Seligman, will discuss twenty-five important original communications, dealing with a wide range of metallurgical and engineering problems and discoveries, at a series of scientific sessions that terminate on September 15th with a steamer trip on Lake Zürich. The remainder of the week will be devoted to a series of tours in Switzerland, in the course of which several large metal works will be visited.

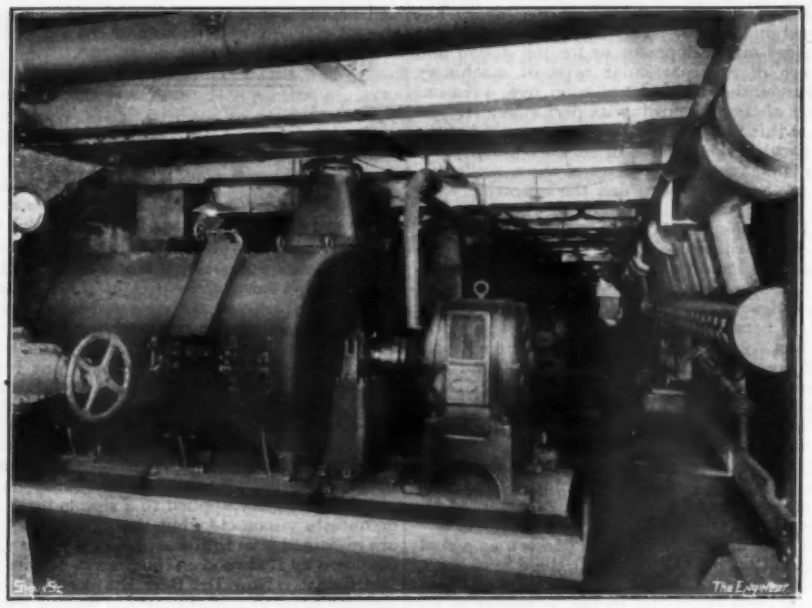
New Steam Plant at Gatineau, Quebec.

ONE of the largest newsprint mills of the International Paper Company and its subsidiaries is the plant of the Canadian International Paper Company, at Gatineau, near Ottawa. This plant has been generating process steam by means of electric power obtained from its associated water power developments on the Gatineau River, but, owing to expansion, it has been necessary to supplement the hydro-electric power with coal-fired boilers. A new boiler plant has been designed by the engineering department of the Gatineau Power Company, under direction of Mr. R. H. Barber, general superintendent of steam plants, and Mr. J. F. Jackson, assistant engineer.

The new plant has been built adjacent to the electric boiler-room and contains four Foster-Wheeler steam generators. It is designed to obtain maximum economical efficiency, and is complete with coal-handling and storage facilities. In addition to high plant efficiency, the outstanding features are compactness and simplicity of design. Although the plant contains the four largest steam generating units in the Dominion, the boiler-room is of only moderate height and has no basement. The overall dimensions of the boiler-room are 51·5ft. high, 61ft. wide and 193ft. long, which includes space left for the installation of a fifth boiler. Low height in the boiler equipment is obtained by an arrangement for removing ashes, which eliminates the necessity of an ash basement, and has, incidentally, reduced the cost of the building. Notwithstanding this compactness, every piece of equipment is readily accessible for inspection and repair.

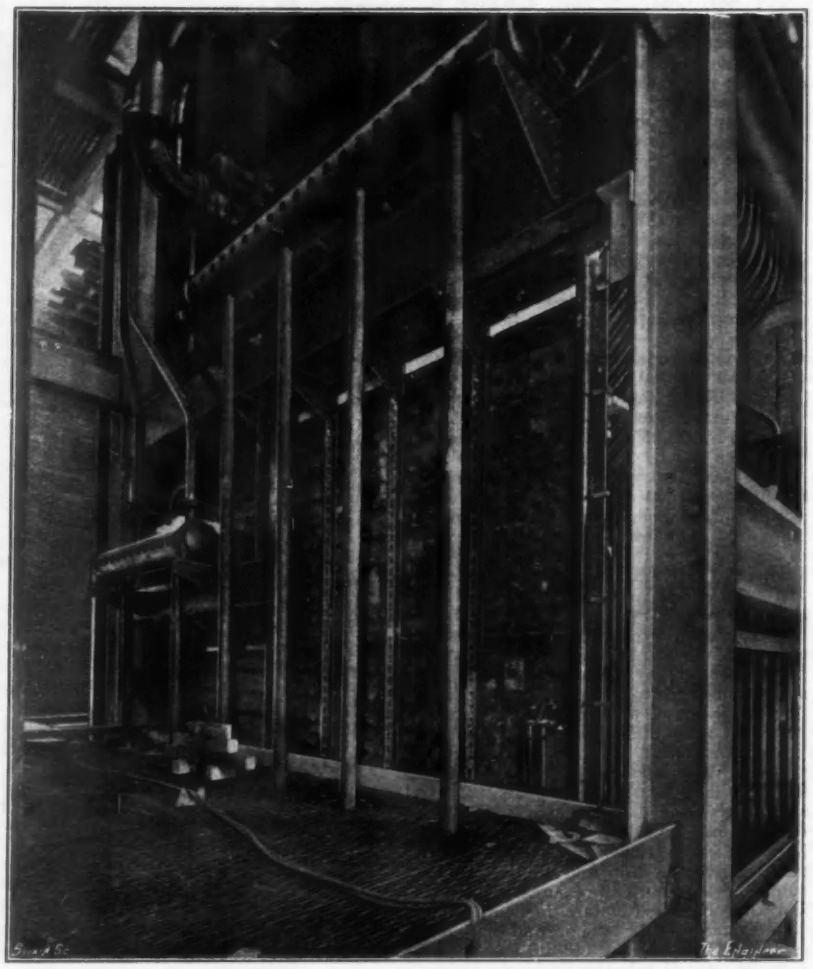
Each unit includes a pulverised fuel system, 1340 horse-power boiler, water-cooled furnace, convection superheater, and tubular type air heater. The four units are served by a common flue connected through induced draught fans to a single radial brick chimney, but each unit has its own forced draught fan. Coal is received by rail, the cars discharging into a hopper, which is emptied by a skip hoist, either into a chute to a drag-line storage system, or into a ring crusher. The crushed coal is delivered by a belt conveyor to an overhead bunker in the boiler-room. The coal on the belt is weighed automatically, so that a permanent record is kept of the total fuel burned in the plant. The bunker in the boiler-room is of the "pant-leg" type, which is self-trimming.

The overhead bunkers feed three pulverisers for each boiler. The pulverisers are of the "aero" impact type, and are arranged on the ground level below the operating floor. Two of them for each unit have a capacity of 7000 lb. of coal per hour, and the third has a capacity of 3500 lb. per hour. These capacities are based on the usually high percentage of moisture contained in Dominion coal when stored outside during the winter months. Each pulveriser is driven by a direct-connected motor.



PULVERISERS ON LOWER FLOOR OF BOILER-HOUSE

Two different sizes of mills are used to give maximum flexibility. The small pulveriser of each boiler is capable of carrying the week-end load. Each pulveriser discharges through a single turbulent-type forced draught burner. The three burners of each unit are adjustable for varying degrees of turbulence and are placed in the front furnace wall at the operating floor level.



OUTSIDE OF WATER-WALL

The furnaces are water-cooled on three sides and have air-cooled refractory front walls. The furnace volume is 6600 cubic feet, which, at normal maximum rating, provides a heat liberation of 22,600 B.Th.U. per cubic foot per hour. The two side walls and rear wall of each unit are of the wing-back construction, consisting of cast iron blocks bolted to the tubes. The furnace floor is of fire-brick and is air-cooled. Ash removal is accomplished by means of a stream of water from a hose with a long pipe nozzle introduced through doors at the rear. The ash is washed out through these same doors into a "Hydrojet" sluice. To facilitate this washing process, the furnace floor slopes to the rear and has ridges of fire-brick 4½in. high from front to rear, dividing the floor into four channels, each leading to one of the four ash doors. The sluice runs the length of the boiler-room and is continued to a sump outside, from which the ash is removed by a grab bucket, the water being re-circulated through the sluicing system.

The furnaces fire 1340 horse-power boilers of the bent tube type. The boilers embody four drums connected by 3½in. tubes. The gas flow through the boilers is arranged in three passes, a bare tube convection type superheater being placed between the first and second passes. The normal working pressure of the units is 200 lb. per square inch, and the boilers will generate 117,000 lb. of steam per hour at normal rating, with a peak load of 136,000 lb. At the normal rating, the flue gas temperature will be 625 deg. Fah., when operating with 14 per cent. CO_2. At this rating, the steam is superheated 60 deg., a higher degree of superheat not being desirable, inasmuch as the steam is used principally for process work. The only steam used for power is that delivered to turbines operating paper machines.

Flue gases from the boilers are delivered to tubular-type air heaters, containing 17,820 square feet of heating surface, from which they pass to a common flue on the ground level. Three induced draught fans, arranged above the flue, deliver the gases to the chimney. The forced draught fan for each unit is arranged on the upper floor of the boiler-room, about 25ft. above the air heater inlet. This distance, which permitted construction of the connection duct without abrupt change of section, assures even distribution of air across the full width of the heater. The air heaters are calculated to reduce the flue gas temperature from 625 deg. to 340 deg. Fah., and heat air for combustion from 70 deg. to 415 deg. Fah. Preheated air is used in the pulverisers for the mill-drying of coal, which increases the efficiency of the mills, the fineness of grinding, and reduces the power required. Preheated air is also introduced as secondary air at the burners. It is estimated that these steam generators will have a continuous overall efficiency during normal operation of 82·5 per cent.

All control apparatus and instruments are mounted on panel boards fixed between each pair of boilers. From the operator's position, it is possible to observe the boiler water level, and also the flow of coal to the pulveriser feeders.

Several views of this new boiler plant are reproduced herewith and on page 270.

Crank Shafts for Double-Acting Diesel Engines.*

By S. F. DOREY, M.Sc., Wh. Ex.

SECTION I.—STRENGTH OF CRANK SHAFTS.

CONSIDERATION of the strength of crank shafts entails a knowledge of the behaviour of materials when subjected to combined straining actions, and in particular combined bending and torsion. Many theories or hypotheses have been advanced for ascertaining the criterion of failure of steel subjected to combined stresses, but it is apparent

* North-East Coast Institution of Engineers and Shipbuilders, March 13th, 1931. Abstract.

that up to the present there appears no decided opinion as to which of these formulæ should be adopted. The following are among the many theories put forward :— (i) maximum principal stress theory ; (ii) maximum principal strain theory ; (iii) maximum shear stress theory or Guest's law ; (iv) the internal friction or Navier's theory ; (v) Mohr's theory ; (vi) Becker's theory ; (vii) the strain energy theory or Haigh's theory ; (viii) Seigle and Cretin's theory for ductile steels ; (ix) Millington and Thompson's hypothesis for failure. It is probable that each of these criterions of strength can be proved to be correct if its application be properly limited. These theories have been deduced by means of the mathematical theory of elasticity or from the results of investigations concerned mostly with unvarying or static stresses, and care should be exercised in adapting them to cases where the straining action is variable. In the latter case, the procedure usually adopted is to calculate the working stress on a structure by means of one of the well-known formulæ and, if the stress so obtained has proved satisfactory in service, to adopt it for the particular case under consideration. Thus, for marine engine shafting the experience gained during the evolution of the steam engine was used for providing a basis for the design of shafting for internal combustion engines, and the working stresses found satisfactory in the former were adopted for the latter type of engines.

In most cases the usual procedure is to calculate the maximum equivalent bending moment M e by means of a formula of the type

$$M\,e = \alpha\,M + (1-\alpha)\sqrt{T^2+M^2} \quad . \quad . \quad . \quad . \quad (1)$$

where M is the bending moment, T the twisting moment, and α varies from 0 to 0·5. Knowing the safe working stress f, the diameter of the shaft is ascertained from the formula

$$d = \sqrt[3]{\frac{32\,M\,e}{\pi f}} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

In using a formula of type (1) it is evident that, unless a

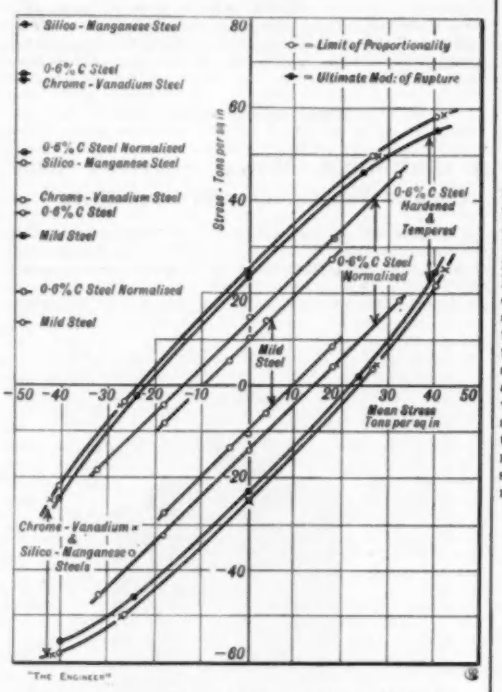


FIG. 1—TORSIONAL FATIGUE LIMITS—HANKINS

reasonable factor of safety is employed, the working stress may require to be altered, as the ratio of bending moment to twisting moment varies. This may be simply illustrated by means of Smith's[1] experiments on 0·2 C steel rods subjected to combined tension and torsion.

Haigh's theory appears to give the most consistent results, but for the ratios of $\frac{T}{T+M}$ greater than 0·5 there is little difference between this theory and the maximum shear stress theory, the limiting stress being practically equal and constant.

For most reciprocating engines used for main propelling purposes the value of the twisting moment used in calculating the diameter of crank shafts is more than double that of the bending moment it is combined with ; so that the maximum shear stress theory is not only the most accurate, but also the most convenient for use.

When comparing one type of engine with another, due regard should also be given to the fluctuations of the twisting and bending stresses themselves. In actual running conditions a reversed bending stress is generally accompanied by a variable torsional or shear stress. For example, in the case of the crank shaft for a triple-expansion steam engine the value of the shear stress due to twisting varies from about +1·0 to +0·6 in one complete revolution of the shaft, for a four-cylinder two-stroke single-acting Diesel engine the torsional stress varies from about +1·0 to −0·44, and for an eight-cylinder four-stroke single-acting Diesel engine the variation is from +1·0 to −0·22. In the former case the ratio of twisting moment to bending moment is about 5·0, compared with 2·5 and 5·5 for the two-stroke and four-stroke Diesel engines respectively. From this it will be appreciated that unless an allowance is made for the difference in the range or fluctuation of stress set up in the shafts of internal combustion engines as compared with steam reciprocating engines the factor of safety based on fatigue or failure under repeated stresses will be less in the former type of engine than the latter for the same working stress.

[1] "Compound Stress Experiments," C. A. M. Smith, "Proc.," Inst. Mech. Engrs., 1910.

If the fatigue limit is known for various conditions of loading, the allowable stresses can be assigned by using the appropriate factor of safety. It will be appreciated, however, that in using the fatigue limit as a criterion of strength a knowledge of the effect of discontinuities on the endurance of the material is of the utmost importance, since the presence of sharp corners, keyways, serrations, screw threads, &c., considerably reduces the endurance for a given stress. It has already been stated that so far as static conditions are concerned the most satisfactory method for dealing with combined bending and torsion is to use the maximum shear theory, and the next question that arises is how far can the results of statical experiments be applied to cases where materials are subjected to repeated stresses. From the results of many researches it appears to be generally considered that ductile materials fail by sliding on certain planes, which points to the fact that shear stresses are the cause of

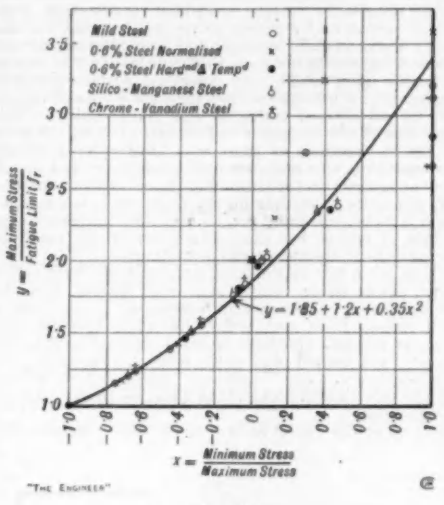


FIG. 2

failure. In the case of tensile loading the pulling out of the specimen by slipping on well-defined planes of weakness of the space lattice has been illustrated by Taylor and Elam's experiments on single crystals of aluminium and iron. Experiments carried out at the National Physical Laboratory by Gough, Hanson and Wright on single crystals of aluminium subjected to repetitions of direct stress, torsional stress, slow cycles of tensile loading and tensile impact tests all point to the conclusion that failure takes place by slipping on the planes of the maximum shear stress. In further experiments carried out on crystal aggregates subjected to a series of torsional stresses at various ranges the slip bands observed were found to be similar to those obtained by straining single crystals in the same manner. Moore and Ver's[2] experiments in connection with the slip lines in metals under repeated stresses also show that slip in multi-grained pieces of metal, and therefore the elastic strength, depends chiefly on the magnitude and direction of the maximum shearing stresses set up.

The results of simple alternating stress experiments show that the maximum shear theory is a safe approximation for ductile materials. Investigations made by Stanton and Batson[3] on specimens of 0·132 carbon steel subjected to rapid alternations of combined bending and torsion, which could have any desired value between the extreme cases of reversals of simple bending and reversals of simple torsion, and further experiments carried out by Mason and Delaney[4] on 0·12 carbon steel subjected to combined alternating bending and twisting, show that the maximum shear stress theory can be extended to combined alternating stresses for ductile materials. A special point arising from these alternating stress experiments is that the normal stress on the plane of maximum shear has no marked effect on the failure by shear, and is similar in this respect to failure under combined static stresses. In this connection it is interesting to note from tests carried out on single crystals of aluminium that, although distortion is influenced principally by shear stresses, the effect of the normal stress is a contributory factor ; in other words, there appears to be a frictional or Navier effect. If, however, as appears to be the case, this effect is small enough to be neglected, the problem of failure due to combined bending and torsion, particularly where the range of torsion is other than completely reversed, may be solved by a consideration of the behaviour of metals under shear stresses of varying ranges when the mean stress is not zero.

Experiments on steels subjected to repeated torsional stresses at various mean stresses have been carried out by Lea[5] and Hankins[6] in this country, and by McAdam[7] in the United States. Lea's experiments were made on steel wires and deal primarily with the failure of helical springs. There is close agreement between the results of McAdam and Hankins, and both point to the fact that the safe range of torsional stress is only slightly dependent upon the mean stress.

Fig. 1 shows the results of Hankins' experiments for a number of steels, and in order to find a relationship between the maximum shear stress permissible and the range of stress, Hankins' tests have been re-plotted as shown in Fig. 2, where the ordinates are the values of maximum stress divided by half the fatigue range for completely reversed stress and the abscissæ are the corresponding values of the ratio x given by

$$x = \frac{\text{Minimum shear stress}}{\text{Maximum shear stress}}$$

The spots indicated in Fig. 2 are not in all cases the actual experimental results shown in Fig. 1, but they are all taken from the curves shown in this figure. The curve shown in Fig. 2 may be expressed by the following equation, viz.:—

$$y = 1\cdot85 + 1\cdot2\,x + 0\cdot35\,x^2 \quad . \quad . \quad . \quad . \quad (3)$$

It is considered that this expression may be taken as representing for all practical purposes a safe relationship between the maximum shear stress and the ratio x for all ductile steels. It will be observed that it applies to the whole range of stress, from the fatigue limit for completely reversed shear stress, to static shear stress calculated by the ordinary theory of elasticity for twisting.

Thus, if f_x = maximum permissible shear stress for ratio x,

f_r = fatigue limit for completely reversed stress,

Then equation (3) may be written

$$f_x = f_r\,(1\cdot85 + 1\cdot2\,x + 0\cdot35\,x^2) \quad . \quad . \quad . \quad . \quad (4)$$

When $x = 1$ the range of stress is zero and $f_x = F_B = 3\cdot4\,f_r$, which is the ultimate shear stress. Similarly, when the minimum shear stress is zero $f_x = f_o = 1\cdot85\,f_r$, and for $x = -1$, that is completely reversed stress, $f_x = f_r$. It is shown in an appendix how equations (3) and (4) may be used to obtain a modified form of the maximum shear stress theory, by means of which it is possible to calculate the size of a shaft subjected to a reversed bending moment M and any variable torque T from the formula

$$\frac{\pi\,d^3}{16}F_B = C\sqrt{T^2+M^2} \quad . \quad . \quad . \quad (5)$$

The value of the coefficient C depends upon the ratio of twisting moment to bending moment, and also upon the fluctuation of torque. The variation of C with these factors

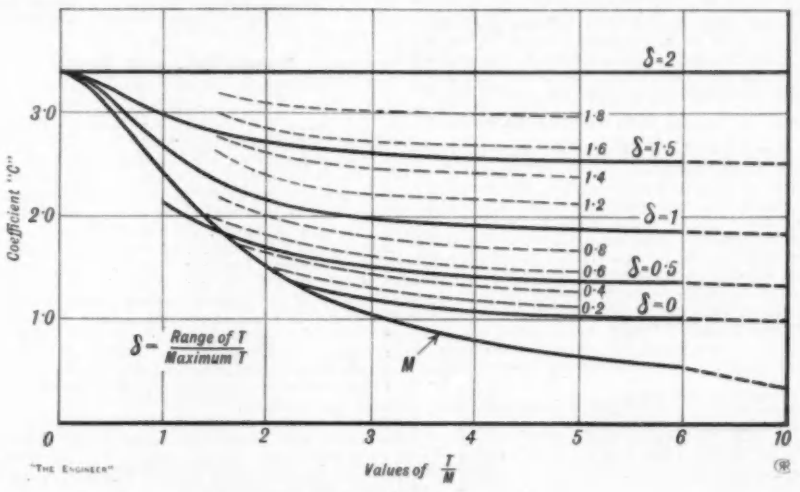


FIG. 3

is illustrated in Fig. 3. In cases of actual design M and T are known and from the ratio $\frac{T}{M}$ the coefficient C can be read off from the curves of Fig. 3 for the appropriate value of δ. The allowable shear stress $\frac{F_B}{C}$ will depend upon experience with existing types of engines. In cases where the twisting moment is nearly constant $\frac{F_B}{C}$ will be the shear stress suitable for static conditions, which will be less than the static yield stress. In the usual types of multi-cylinder marine engines the suitable value of $\frac{F_B}{C}$ will be based on the fatigue limit of the material of the crank shaft. In fixing

[2] "A Study of Slip Lines, Strain Lines and Cracks in Metals Under Repeated Stress," H. F. Moore and T. Ver, University of Illinois Bulletin, No. 208.

[3] "The Fatigue Resistance of Mild Steel Under Various Conditions of Stress Distribution," T. E. Stanton and R. G. Batson, British Assoc. Report, 1916.

[4] "Alternating Combined Stress Experiments," W. Mason and P. Delaney, British Assoc. Report, 1921.

[5] "The Failure of Some Steel Wires Under Repeated Torsional Stress," F. C. Lea and F. Heywood, "Proc.," Inst. Mech. Engineers, 1927.

[6] Discussion on (5) ; also "Torsional Fatigue Tests on Spring Steel," Department of Scientific and Industrial Research Special Report, No. 9.

[7] "The Endurance Range of Steel," D. J. McAdam, jun., "Proc.," American Soc. Testing Materials, 1924, Volume 24, Part II.

the working stresses some fraction of the fatigue limit must be taken to allow for discontinuities, &c. Also, in considering marine engine shafting there are many other items for which due allowance must be made, such as alignment, bending of shafts due to movements in the hull structure, unequal loading of the vessel, shocks on the propeller, unequal wear of bearings. For the present it is suggested that a factor of safety of 1·5 based on the fatigue limit f, in shear would allow for discontinuities, and a factor of 3 a suitable allowance for discontinuities and the other items just mentioned.

SECTION II.—WORKING STRESSES IN CRANK SHAFTS OF STEAM RECIPROCATING ENGINES AND SINGLE-ACTING DIESEL ENGINES.

It is now proposed to apply the method given in Section I. to existing shafting of steam reciprocating engines and single-acting Diesel engines of the two and four-stroke cycle type. To ascertain the actual working stresses in existing engines the following procedure has been adopted. In the first place, trial results of twenty-two triple-expansion steam engines obtained from eight different makers of repute were analysed, and from these particulars the stresses acting on the crank shafts per revolution were calculated. The ratio of $\frac{T}{M}$ for maximum combined stress conditions was also obtained, together with the range of torsional stress during one revolution of the shaft. The stresses were calculated with and without allowing for the effects of the inertia of the reciprocating masses. The average working stress for a wide range of sizes of triple-expansion steam engines was thus obtained. A similar analysis was made in respect of 2-s.c.* and 4-s.c. single-acting Diesel engines. In the case of the Diesel engines, in order to obtain uniformity, a common mean indicated pressure of 105 lb. per square inch was assumed. This mean pressure may be slightly on the high side, but it is thought that it is a pressure which could be obtained for a period of running of the engines in actual service. Nineteen six-cylinder and sixteen eight-cylinder 4-s.c.s.a. engines have been dealt with, together with twelve four-cylinder, nine six-cylinder and eight eight-cylinder 2-s.c.s.a. engines.

The stresses in some of the steam engines and single-acting Diesel engines investigated are given in tables which accompany the original paper. The stresses due to torque only and also for combined bending and torsion have been calculated with and without allowance for the effect of the inertia of the reciprocating parts. The ratios of $\frac{T}{M}$ at T_e max. have been tabulated together with the range of torsional stress during one revolution of the crank at which T_e max. occurs. The bending moment combined with the twisting moment is assumed to be an alternating bending moment.

From these particulars the basic static shear stress for any type of engine can be calculated, since δ and $\frac{T}{M}$ are known and the coefficient C is obtained from Fig. 3. If f_s max. is the shear stress due to maximum combined twisting moment, T_e max. the (equivalent twisting moment), the basic static shear stress F_B is given by $F_B = C \times f_s$ max. The working stress for completely reversed shear stress will be given by $\frac{F_B}{3 \cdot 4}$. For all the steam engines it was found that the basic shear stress varied considerably, namely, from 12,600 lb. per square inch for a small fast-running engine to 6100 lb. per square inch for a 27in. triple; but in the latter example the engine was not running at full power, there being a difference of 20 lb. between the boiler pressure and pressure at high-pressure cylinder. The average f_s max. for the eight engines is 5920 lb. per square inch, giving a value for F_B of 8420 lb. per square inch and a working stress for completely reversed torsional stress of $\frac{8420}{3 \cdot 4} = 1 \cdot 11$ tons per square inch. Taking the value of 7·5 tons per square inch for the torsional fatigue limit of 28/30 tons mild steel, as against 10 tons per square inch for 0·13 C steel of Hankin's experiments, the factor of safety would be nearly 7, which appears to be rather high. The average value of f_s max. for running conditions is 5600 lb. per square inch with allowance for the effects of inertia of the reciprocating parts and 5270 lb. per square inch for static conditions, a difference of 2 per cent. on diameter, say, ¼in. on 12in. diameter shaft.

The value of the basic static shear stress F_B for each type of engine is given below :—

Type of engine.	Basic static shear stress, lb./sq. in. F_B.
1. Triple-expansion steam engine	8,420
2. Six-cylinder 4-s.c.s.a. Diesel engine	10,660
3. Eight-cylinder 4-s.c.s.a. Diesel engine ..	11,690
4. Four-cylinder 2-s.c.s.a. Diesel engine	12,100
5. Six-cylinder 2-s.c.s.a. Diesel engine	10,930
6. Eight-cylinder 2-s.c.s.a. Diesel engine	9,290
Average	10,515

Diesel engines most common in use are six and eight-cylinder 4-s.c.s.a. engines, and four and six-cylinder 2-s.c.s.a. engines, and from the information available, crank shafts for main propelling purposes have behaved satisfactorily in practice when the diameters have been made in accordance with Lloyd's Rules.

Taking the average value of 2, 3, 4, and 5, the basic shear stress is 11,345 lb. per square inch. The latest Lloyd's Rules allow slightly smaller shafts for 6, which brings the basic stress for this engine up to 9900 lb. per square inch. It was therefore decided to use a static shear stress of 11,200 lb. per square inch as a basis for determining suitable diameters for crank shafts of double-acting Diesel engines. This static shear stress, namely, 5 tons per square inch, is less than the torsional fatigue limit of 28/32 tons steel. The safe working stress for completely reversed torsional stress will be given by $\frac{11,200}{3 \cdot 4} = 3300$ lb. per square inch; so that the factor of safety will be about 5 on the torsional fatigue limit.

It will be shown later that for eight and ten-cylinder 4-s.c.d.a. engines the static shear stress may be reasonably increased above 11,200 lb. per square inch on account of the reduction of the large fluctuations in torsional stress due to the fly-wheel effect of the heavy rotating and reciprocating masses. With the smaller variations of torque in 2-s.c.d.a. engines this effect is not so pronounced.

(To be continued.)

* The following abbreviations are used throughout the paper :—s.c. = stroke cycle ; s.c.s.a. = stroke cycle, single acting ; s.c.d.a. = stroke cycle, double acting.

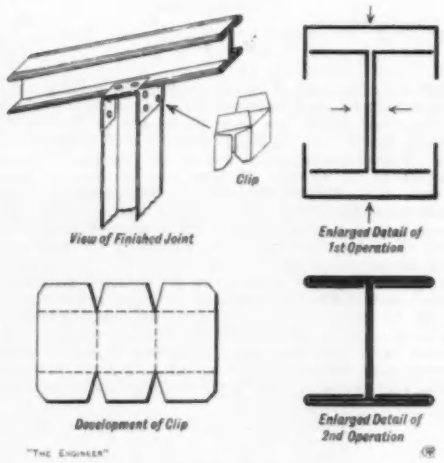
The Model Engineer Exhibition.

As announced in our issue of last week, the Model Engineer Exhibition, in the Royal Horticultural Hall, Westminster, closes to-morrow, so there is still time for visitors to go and explore its many interests.

The cult of model making, it should be pointed out, is not necessarily merely a childish amusement, even if it is carried on by grown-up people, but may involve a high degree of skill, foresight and inventiveness, so that it serves an admirable means of maintaining the supply of brains upon which our industrial system depends. Incidentally, it provides a most innocent means of recreation for all classes, technical and non-technical. This latter side of the subject is well brought out by the wide variety of vocations of those who have entered models in competition, who range through tobacconists and signalmen to engineers and accountants. There is also a remarkable difference in the handicraft displayed in the models, which is to be accounted for, we feel sure, in many cases, by lack of means, but must sometimes be the result of an enthusiastic desire to attain completion.

There are a few of those remarkable little craft called model power boats, which are never models, but the demonstration of the art of cramming power into a small space. It is noteworthy that those builders, and there are several, who have adopted internal combustion engines have turned out much more workmanlike jobs than heretofore. The "steamers" seem to have settled down to an orthodox design, with a single-cylinder reciprocating engine.

Several of the model railway clubs have exhibits, and there is, of course, the running track across the end of the hall on which visitors are drawn by model locomotives. The remarkable power of these little engines was demonstrated on the occasion of one of our visits, when the locomotive broke away from its train and ran forward unloaded and unattended. It took the utmost efforts of two men to restrain it long enough to shut off steam. And it is only about 2ft. 6in. long.



MODEL BUILT-UP JOISTS

Among the other exhibits of general interest is a fine model of Sydney Harbour Bridge, which is made very realistic by spanning a tank of real water. It is modelled to the scale of one-twentieth of an inch to the foot, and is 20ft. long. The bridge and the buildings on both shores are provided with electric lights, so that, with the room darkened, its appearance at night-time can be appreciated. Another bridge model, nearly as large, represents a proposal for a new Charing Cross Bridge, put forward by Mr. A. G. Waller, an architect.

In the trading section of the Exhibition, one of the most novel and interesting things which we have found is a miniature form of structural steel, much more realistic than any we have seen before. We give a few sketches to illustrate its application.

The sections, which are true one-eighth scale models, are made by Brunton and Trier, Ltd., of 38, Felsham-road, Putney, London, S.W. 15. They comprise I beams, channels, tees, angles, flat bars and bracing sections with curled edges. It would, of course, be impracticable to roll a section ¾in. deep and of a thickness in proportion, so an ingenious subterfuge has been adopted. The section is built up of thin sheet metal. The I beam, for instance, is formed, as shown in the sketch, of two channels placed back to back and held together by two other channels slipped over the flanges and folded over. The result is that the flanges are, appropriately, one and a half times the thickness of the web and a remarkably stiff section is produced. The folds and joints are hardly visible without the help of a magnifying glass.

For the purpose of making the junctions between the members of a structure an ingenious set of sheet metal clips has been evolved. We illustrate one of these for connecting, for instance, a floor beam and a column. It is supplied already bent, so that it can be slipped over the end of the column. The lugs are then bent round the flanges of the section by means of flat-nosed pliers and are "riveted" in place. The riveting, again, is ingenious, and is effected with the aid of a powerful pair of pliers. One of the jaws is fitted with a little ball and the other jaw has a corresponding recess. The joint is squeezed between these jaws, with the result that the several folds of metal are indented one into the other and a bump appears on one side, which resembles a rivet head. It makes a surprisingly rigid joint.

A new type of electrically heated soldering iron is being exhibited by W. T. Henley's Telegraph Works Company, Ltd., of Holborn Viaduct, London, E.C. 1. Its chief peculiarity lies in the arrangement of the heating element close up to the working end of the copper bit, so that the heat is well maintained even when a heavy job is being soldered. We tested this characteristic at the Exhibition, and although the iron is quite light in the hand—we should say that it does not weigh more than a pound—it would do jobs that would not be easy with a normal iron with a 16 oz. bit. The reason is, of course, the continuous supply of heat from the electrical element. No. 14 gauge copper, of reasonable dimensions, can, for instance, be soldered surely and quickly as a lapped joint. The current consumption of the iron is about 200 watts.

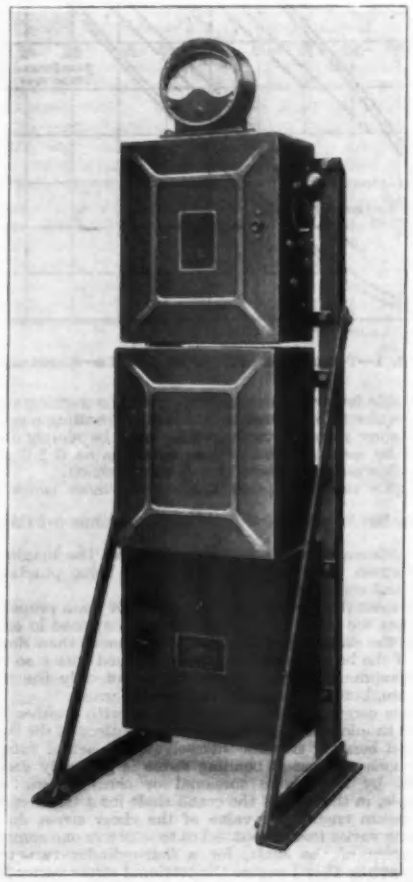
We missed, this year, the excellent display of workmanship from the Royal Aircraft Apprentices' Establishment at Halton, but there is in its place a similar show from the Army Technical School, at Chepstow. The examples of work shown indicate that the lads are well taught in accuracy and carefulness, and are, perhaps, even more diverse than those of the Air Force. The instructors whom we met on the stand are full of enthusiasm.

There are, of course, several exhibits of small machine tools, by such firms as Drummond Bros., of Guildford; Tom Senior, of Liversedge, Yorks.; Buck and Ryan, of 310, Euston-road, London, and the Exe Engineering Company, of Exeter; but their products are so familiar to our readers, and there has been so little change in the designs during the past year, that it is hardly necessary to enlarge upon the individual machines here. It is sufficient to say that the model engineer can find examples of all the equipment he should require.

Finally, there is one fascinating stand where Mr. G. M. Grace is demonstrating that old-fashioned art of ornamental turning. He has a lathe at work producing some most intricate patterns, and equipped with many "gadgets." He is most pleased to talk with anyone who is really interested in the subject. In fact, that is the whole air of the Exhibition.

A Combined Motor Starting and Power Factor Correcting Panel.

THE practice of connecting a condenser across the terminals of a motor or a number of motors for the purpose of correcting the power factor is, of course, well known, and it can often be shown that when electricity is paid for on the kVA basis the resulting improvement in the power factor represents an appreciable saving. Low power factors cause supply undertakings to incur unproductive expenditure, and many of them have, therefore, found it necessary to charge for power on the basis of kVA instead of kW. There are, of course, several ways of raising the power factor of induction motors, but a fairly common and very convenient method is to employ a condenser. Hitherto, these condensers have formed independent units, but the Electrical Construction Company, of Wolverhampton, has recently introduced a motor starting panel, in which all the necessary gear



STARTING AND POWER FACTOR CORRECTING PANEL

for starting, protecting and improving the power factor of a squirrel-cage machine is contained.

One of these combined starting and power factor raising panels is shown in the accompanying illustration, which relates to an air-break unit with an auto-transformer and condenser combined. In the smaller sizes the auto-transformer switch is of the air-break type, and the auto-transformer is air-cooled, whilst in the larger sizes the switch is oil-immersed, the transformer being air-cooled, as in the case of the larger units. If desired, an ammeter can be fitted as shown in the illustration. The operating switch has time lag overload and no-voltage devices, and the operating handle has the usual three positions, "off," "starting" and "running." A special arrangement of contacts, forming the subject of a pending patent, enables the auto-transformer and condenser to be used jointly in the running position of the switch, so that an economical design of condenser may be employed. On some supply systems, where the kVA system of charging is not in vogue, the power factor is restricted to a certain value, such as 0·8, and under these conditions, this combined system of starting and power factor correction, introduced by Mr. Human, is claimed to be very advantageous. The power factor of a motor depends largely on its design and speed. A normal motor running at 1000 r.p.m. may have a power factor of 0·85, which, by means of the unit under consideration, may be raised to 0·95. The system does not involve any complications in the wiring, for three cables are led into the starter and three are taken from the starter to the motor in the usual way.

SIXTY YEARS AGO.

FOLLOWING the conclusion of the Franco-Prussian war, the industries of this country entered in the autumn of 1871 upon a period of great activity. In our issue of September 15th of that year, all our provincial correspondents continued to report good prices and full order books in the engineering and allied trades. From the Midlands it was reported that engineers and founders were being forced daily to reject orders. Iron could only be obtained in exceptional cases, and then in merely small quantities and at enhanced prices. In the Middlesbrough district the amount of business being done in pig iron was described as enormous. Every furnace was at work and the output was bordering upon 160,000 tons a month. On the Tyne, Wear and Tees every shipbuilding yard was fully occupied. Any ship built for sale was sought by two or three purchasers as soon as she was launched. The Scottish iron rolling mills were working double shifts and even so could scarcely keep the supply equal to the demand. From Sheffield it was reported that the steel trade was remarkably busy and that new works for the production of Bessemer were being erected. Only from South Wales came a note of of complaint. In a few weeks' time the rail-makers of that district, it was reported, would have finished the large orders upon which they had recently been engaged, and some anxiety was being expressed concerning the receipt of fresh contracts. In the midst of this almost universal tale of prosperity our correspondents had to record a growing restiveness on the part of labour. At Brierley Hill the puddlers were demanding a rise of 10 per cent. in their wages, and the movement was spreading to their brethren in South Wales and Monmouthshire. An advance of that amount had recently been granted to the iron workers in the North of England. In Scotland the iron workers had been given a 5 per cent. advance and were threatening to strike unless they received a further 5 per cent. increase. In the engineering industry in the North of England 9000 men had come out on strike sixteen weeks previously on their being refused a reduction of hours to nine per day. Organised by the Nine Hours' League, they remained adamant in their demand, but most of them succeeded in finding work outside the district, and, gradually, the number of idle hands had fallen to about 2000. The employers, too, remained fixed in their determination not to reduce the working hours, and with the aid of apprentices and labour imported from the Continent, had succeeded in keeping their establishments in operation. Many of the foreign workers, it was reported, had never been inside an engineering works before they came to Newcastle, and there were numerous tales of valuable work which they had spoilt. Feeling was beginning to run high, and the magistrates had to deal with numerous cases of assault on the foreign workers. In one works there was no strike. Throughout the trouble the men in the employment of Robert Stephenson and Co. continued to work on the old ten-hours day terms. They had a strong personal attachment to the head of the firm, Mr. G. R. Stephenson, and were quite willing to leave the decision of the question of hours in his hands.

ENGINEERING GOLFING SOCIETY.—The autumn meeting of the Engineering Golfing Society will be held on Wednesday, September 30th, 1931, at the Stoke Poges Club. The morning programme will consist of an 18-hole medal round for the "Hele-Shaw" Scratch Challenge Cup and Memento, the "F. J. Walker" Challenge Cup and Memento for the best net score under handicap in the first division, and the "P. B. Brown" Challenge Cup and Memento for the best net score under handicap in the second division. The afternoon will be devoted to "foursomes" 18-hole match play against bogey for the "Hadfield" Challenge Cups. The entries for this meeting close on Wednesday, September 23rd, 1931.

THE SIR JOHN CASS TECHNICAL INSTITUTE.—The new session of the Sir John Cass Technical Institute, Jewry-street, Aldgate, E.C. 3, which extends over about thirty-six weeks, will begin on Monday, September 21st, and students will be enrolled during the preceding week. A booklet describing the metallurgical laboratories of the Institute has been sent to us. There are relatively few laboratories of the kind available for part-time day and evening students, and we observe that the equipment here appears to be excellent. The fees are low, only 20s. for one evening per week, and 35s. for two evenings per week for the whole session, September to June. Mr. George Patchin, A.R.S.M., Principal of the Institute, is head of the Metallurgical Department.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondents.)

Trade Situation.

MANY of the important industries in the Midlands and Staffordshire remain dormant, but automboile engineering and some of the lighter trades are showing improvement. There is a slackness in general trade circles, due to the uncertainty of the present national position, but with enlightenment it is hoped and believed that industry will go forward. The autumn should bring renewed vigour and a period of gradual trade recovery is looked for. Inquiries in circulation are encouraging, and it only needs settled conditions and confidence for many of them to materialise. On the other hand, the call for economy will undoubtedly prevent many development schemes being put in hand by local authorities. The Government plans are eagerly awaited, for until they are made known business will be more or less suspended. There has been little business transacted on 'Change in Birmingham this week, and iron and steel values are much as they were a week ago.

Steel.

The steel mills hereabouts are working on a hand-to-mouth basis, and there is no sign of any improvement. Users' requests for early delivery of small quantities necessitate frequent roll changing. Most of the steel-consuming industries in the Midlands and Staffordshire are at the moment subdued, but there are a few inquiries coming through for autumn contracts. Some rolling stock orders have come into the district and iron and steel will be needed by the works a little later on. Competition is very keen for all structural work, and orders when secured often prove unproductive of profit. Rollers of plates are notably short of specifications. Makers of special steels speak of the possibility of plant extensions, buying recently having improved and available supplies being limited. They are for the moment acting cautiously, but if the improvement takes definite shape arrangements will be made to satisfy all demands. Finished steel prices are unchanged on the basis fixed by the Steelmasters' Association at £8 7s. 6d. for angles, £8 15s. for joists, and £8 17s. 6d. for plates—all subject to rebate. Price-cutting in the steel half-products department continues, and market values are gradually deteriorating. Native billets are now offered in Birmingham at £4 17s. 6d. upwards. Sheet bars are as low as £4 12s. 6d. Small steel bars re-rolled from foreign material are named £6 7s. 6d. upwards, and all-British £7. Interest in continental semis is lacking, despite the low prices quoted by Birmingham merchants. It is reported that £3 17s. 6d. delivered would be accepted for 2in. billets and £4 9s. for small steel bars.

Raw Iron.

The pig iron market generally is quiet, and shows no change on the week. Some blast-furnacemen still say that business is showing a slight improvement, specifications for delivery being better. Definite signs of trade reinvigoration were non-existent in the Birmingham iron trade this week. In Derbyshire the iron needed for cast iron pipe production accounts for a fair proportion of the output of the furnaces, and smelters are able to dispose of the remainder on the open market. Northamptonshire furnacemen are not so fortunately placed. Their production is in excess of consumptive requirements, and stocks at the furnaces are reported to be becoming somewhat unwieldy. Northamptonshire makers of pig iron say that they are not now selling so much iron in Northern markets. If the demand for foundry iron is poor, that for forge grade iron is even worse; indeed, it may almost be said to be negligible as far as the Black Country is concerned. Values, as fixed by the Producers' Association, are upheld. Derbyshire and North Staffordshire No. 3 foundry irons are quoted £3 6s. delivered at stations and forge at £3 1s. Northamptonshire No. 3 foundry is £3 2s. 6d. and forge £2 17s. 6d. Ironfounders in this area, though not well employed, speak of more active conditions in the near future. One local firm has just completed an enterprising scheme with the intention of capturing a large share of the light castings trade. The scheme includes, I understand, the erection of a new foundry on the most modern mechanised lines, the capacity of the plant being 175 tons of castings per week.

Finished Iron.

In the Staffordshire finished iron trade the depression persists. One or two favoured firms which produce best grade bars are experiencing a steady run of business, but it is only in these isolated cases that mills have operated regularly. In the iron trade generally work is confined to some three days a week, and even then output is circumscribed. While marked bar prices are firmly held at £12 per ton at makers' works, a gradual deterioration is going on in other branches of the industry. Crown bars are selling at anything down to £9 5s., and ironworks, which lately held out for something over £10 per ton, are now ready to accept orders at below that figure. Much depends, of course, upon the quality of the iron, there being no fixed standard for Crown quality bars. Common bars for the nut and bolt and fencing trades are slow of sale. While some firms ask £8 7s. 6d. for their production it is asserted by a number of buyers that supplies are to be obtained at £8 5s. Continental bars of No. 3 quality are to be had at £4 10s., and the larger portion of the material in use at local works is of Belgian origin. There has been no improvement in the buying of iron tube strip, and mills are badly in need of additional orders. Values are steady at £10 12s. 6d. per ton.

Galvanised Sheets.

The market for galvanised sheets is decidedly weak, but values do not appear to have declined further. Many local mills continue to quote 24-gauge galvanised corrugateds at £9 5s. per ton, but business is pretty generally done at £9. It is very much a question of bargaining. Export demand is much below par, while home consumers are buying less than of late. Millowners in this district are very worried. They have difficulty in keeping mills in operation, and their outlook is very restricted.

Constructional Engineering.

Constructional engineering firms in the Midlands are but poorly employed, and in the Black Country it is exceptional to find a firm with anything like steady employment. The few contracts in hand are such as to afford engineers no lengthy outlook, and it is commented upon that little of the work in hand, or in prospect for that matter, has any relation to industrial development. The present necessity for economy is almost certain to retard local authorities' development schemes, and on the whole the outlook for the industry is not bright. Builders of bridges are poorly employed, and there is no evidence of an early improvement.

The Automobile Trade.

The position in the automobile engineering industry in the Coventry, Birmingham, and Wolverhampton districts is slowly improving. Many, if not most, of the firms are getting on to production with their 1932 models, and, judging by the large contracts already secured by local firms, steady work should be assured for some time ahead. Indications are that it is in the light car shops that activity is likely to be most pronounced. In the heavy transport section of the trade business is quiet, but firms in this area are enjoying a fair share of whatever trade is going. Motor car manufacturers, while realising the difficulties of the present position of the country and of its workers, are yet optimistic as to the future of their particular industry.

Unemployment.

Although unemployment has decreased on the week in eleven districts out of the twenty-three constituting the Midlands division, the number of persons workless in the whole area is 14,000 higher. There are now 267,464 wholly unemployed, 146,369 temporarily stopped, and 686 normally in casual employment, making a total of 414,519, which is an advance of 122,577 on the corresponding week last year. In the Birmingham area there is a welcome decrease this week of 250, but it is little when compared with the 1000 advance in the two previous weeks. In the Stoke-on-Trent district the position continues to mend, the total unemployed being down to 37,362. Among the towns showing increases are Northampton, Nottingham, Derby, Smethwick, West Bromwich, and Wolverhampton. Of the grand total for the area, no less than 284,138 of the unemployed are male adult workers.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Heavy-oil-engined Omnibuses.

THE Transport Department of the Manchester Corporation during the past few months has been playing a prominent part in pioneering work connected with new developments in the field of road transport. A week ago in this letter reference was made to the test under road conditions of the regenerative type of electric tramcar which the Transport Department here was conducting on behalf of the Municipal Tramways Association. Since the beginning of the present year, officials of the Department have also had under close observation the heavy-oil-engined motor-bus, several of which have been running for some time on the city routes under normal conditions of service. Although the first cost is higher, the additional expenditure is more than offset by substantial economies in fuel costs, and it is probable that the fleet will be considerably extended. Managers of municipal transport services in various parts of the country were expected to be present at the demonstration of different types of high-compression engines which the Manchester Transport Department had arranged at the Hyde-road depôt towards the end of this week, one of the objects being to demonstrate the developments that have recently taken place in the design of oil engines for road purposes.

The Haweswater Scheme.

An animated discussion arose at the last meeting of the Manchester City Council concerning the financial side of the arrangements made with Mr. L. Holme Lewis, who recently retired under the age limit of sixty-five from the position of chief engineer to the Waterworks Department, but whose services were retained as engineer-in-charge of the Corporation's Haweswater scheme at a non-pensionable salary of £2500 a year, the appointment to terminate on the conclusion of the work, or on Mr. Lewis reaching the age of seventy. The discussion arose on an alleged proposal of the Estimates Sub-committee to pay Mr. Lewis a superannuation allowance of £900 a year in addition to the salary of £2500. It was explained that the Finance Committee had referred back any proposal on the matter in order that the advice of the Town Clerk could be obtained. Sir William Kay, who is chairman of the Waterworks Committee, has since stated that the work of the engineer-in-charge of the Haweswater scheme, which is estimated to cost about £10,000,000, is one of great magnitude, requiring the highest engineering skill, and would normally be carried out under the direction of consulting engineers and not by permanent whole-time waterworks engineers. If this course had been followed, said Sir William, fees very largely in excess of anything which Mr. Lewis would receive would have been payable.

Machine Tools for Russia.

A large contract for machine tools for Russia said to be valued at about £250,000, has been secured

by Craven Brothers, Ltd., of Reddish, near Stockport. The works are expected to be kept busy for at least eighteen months.

Non-ferrous Metals.

Weakness has been general in all sections of the market for non-ferrous metals during the past week, and the recent hopes of improving conditions seem, for the time being, to have given way to a fresh spell of uncertainty. Naturally, tin has been the chief centre of interest, especially in view of the latest output restriction, and marketing plans and the consequent firmness of the metal, with the steady advance in price since about the beginning of August. On balance for the week, there has been a loss of about £5 10s. a ton, due, in part, to profit-taking after the rise, but partly, also, to the unfavourable showing made by the latest statistics. Speculators are still ready to take advantage of opportunities, but there has been a marked return to the caution which had for so long characterised trade buying. The trade demand is poor also in respect of copper, and the recent relative steadiness of the metal has been replaced by pronounced weakness. The loss of about £1 10s. a ton in standard copper since a week ago has more than wiped out the gains registered since mid-August, and previous low "records" have been broken. No new features have presented themselves, the position still being essentially one in which consumption is dominated by excessive supplies. A poor trade demand for lead and a certain amount of speculative unloading have resulted in marked weakness, which has brought prices back to where they were at the beginning of June. Although the statistical position of spelter is not quite so bad as it was several months ago, values have been sympathetically influenced by the declines in other sections, and the loss on the week has been relatively serious.

Iron and Steel.

After the slightly better conditions reported a week ago in the Lancashire iron and steel markets, the movement of material, especially in the foundry iron section, has been less active. Pig iron users, for the most part, have covered their prospective needs over the next few weeks, and business has again reverted to a humdrum character, sales in Lancashire still being adversely affected in no small degree by the cheap supplies of scrap material. For delivery to users in the Manchester district, Derbyshire, Staffordshire, and Cleveland pig iron are all quoted at 67s. per ton, Northamptonshire brands at 65s. 6d., Scottish at 86s. to 86s. 6d., and West Coast hematite at 81s. Bar iron prices keep steady at £9 15s. for Lancashire Crown quality, and £8 15s. for seconds, but the demand remains on a poor scale. A moderate steel tonnage, composed almost entirely of small specifications, has been booked by rollers this week, contract buying of any importance still being conspicuously absent. The range of prices is £8 15s. for joists, £8 7s. 6d. for sections, £8 17s. 6d. for general plates, £8 17s. 6d. for boiler plates, £9 7s. 6d. for 3in. bars, and about £6 10s. for small re-rolled bars. There is nothing resembling general buying of imported materials here, although the low prices now being asked have brought out one or two fair-sized orders.

BARROW-IN-FURNESS.

Hematites.

The condition of the hematite pig iron trade of this district is most unsatisfactory. Business is exceedingly quiet all round and there are no signs of any immediate improvement. Trading is from hand to mouth, with only small parcels being placed. All through the district heavy stocks of iron are held. Sales are taking place from those stores where iron is not being made. The absence of any local demand on the part of steel makers is a continued weakness. There is very little demand for iron ore, and only three furnaces are in operation. In the steel trade the main plants at both Barrow and Workington are still idle for want of rail orders. At Barrow the hoop departments are engaged to meet fair demand for hoops, strips and spring steel. There is little activity in foundry work. Fuel is in small demand. Last week a cargo of pig iron left Barrow for Antwerp and a cargo of steel billets arrived in Barrow from Antwerp.

SHEFFIELD.

(From our own Correspondent.)

Steel Production in July.

STATISTICS of steel production for July are now available, and they show that the Sheffield district registered some advance on June, but was still a long way behind the corresponding period of last year. The figure for the recent month was 70,900 tons, including 24,300 tons of acid and 39,800 tons of basic material. The output in June was only 56,800 tons, but in July last year the total was 82,200 tons. During the seven months ending July, the output of steel in the Sheffield area was 455,300 tons, as compared with 637,800 tons in the similar period of last year. There is no improvement to record at present. The number of furnaces in operation remains very small, and both orders and inquiries are lacking in bulk.

Conditions in Lincolnshire.

In North Lincolnshire, July differed very little from June. The output of steel in the more recent month was 36,500 tons, or only 300 tons more than in the earlier. In July of last year, the total was no less than 63,200 tons. Lincolnshire's pig iron production in July was 35,300 tons, as compared with 34,300 tons in June, and 59,100 tons in July, 1930. It is not likely that the figures for more recent months, when they come to be published, will show any advance. The latest report from that district is that the one furnace which has recently been in operation at the Trent Ironworks, Scunthorpe, is to be damped down for a time, owing to the large amount of stock on hand. The works, which are the oldest and smallest in the district, belong to John Brown and Co., Ltd., and have only been operating half-time for six or eight months. Their closing down will affect about 130 men. They will be the third works to be closed down at Scunthorpe within the last two years. The two principal firms in the district will be the only ones left working. These are United Steels, Ltd., at their Frodingham and Appleby Steel and Iron Works, and John Lysaght, Ltd., at their Normanby Park Iron and Steel Works.

The General Position.

The state of local trade as a whole is flat. While confidence in the future has revived a little, there is a great disinclination to place forward business until the Government's economy plans are known. The output of the steel works recently has not changed much from one week to another, though it is probable that the present turnover is rather less than that of the days immediately before the holiday stoppage. Low-grade semi-steel from the Continent can be had at rates very favourable to buyers. There is a great scarcity of work in the railway and shipbuilding steel departments. For special tool steel and tools there is a moderate home demand, and the export trade shows some improvement in the case of the Colonies. There are complaints in all branches of trade of the smallness of individual orders. There is a growing habit, on the part of buyers, of ordering from hand-to-mouth, and they require immediate delivery. Under these conditions, profits are naturally reduced, or altogether eliminated. The special departments are better employed than those which do a general trade. Activity in those branches which supply automobile makers with parts of cars, and with alloy steel, is much below the level of a couple of years ago, though still substantial, and reports which have recently been published, as to the large orders for cars booked by several firms, encourage hopes of progress in this department.

Stainless Steel Reflectors.

The demand for stainless steel, heat and corrosion-resisting steels, is well sustained. The use of stainless steel for projecting light is growing, for polished reflectors of this material have twice the reflecting power of the best vitreous enamel, and are, therefore, economical in the use of light. These reflectors have been in use for some time for illuminated signs, flood-lighting, and other purposes. The flood-lighting of the Horse Guards Parade, and of the upper façade and towers of the War Office, in connection with the Illumination Congress, was carried out by means of reflectors made of "Anka" stainless steel manufactured by Brown, Bayley's Steel Works, Ltd., Sheffield. Thirty 1000-watt parabolic and spherical reflectors were installed for these illuminations. Some of Messrs. Brown, Bayley's own workshops at Sheffield are flood-lighted by means of stainless steel. While on the subject of flood-lighting mention may be made of the fact that, in connection with extensions which have recently been carried out at Rotherham Hospital, the institution has been flood-lighted by means of gas. Mr. J. T. Haynes, engineer and manager of the Corporation Gas Department, was responsible for the adoption of this method of illumination, being of opinion that gas could achieve the same results as electricity, and it is generally agreed that the effort has met with complete success. Twelve lamps, giving a total candle-power of approximately 25,000, were used. They were of the standard type for street or shop front lighting, the only aid to flood-lighting being a set of home-made reflectors, and the gas which they consumed cost only about 6d. per hour.

Heating Installations.

The manufacture of apparatus and material for central heating is one of the healthy branches of local industry, which is represented at both Sheffield and Rotherham. The makers had a very successful time last season, and, having begun the present season with good order books, expect to be fairly busy for some months. The work is keenly competed for, however. The Brightside Foundry and Engineering Company, Ltd., one of the firms engaged in this trade, has recently entered into an agreement with the patentee of a system of oil firing for central heating plants, and has already installed several with very satisfactory results. This system of oil firing is also suitable for almost all kinds of furnaces, such as lead melting, hardening and tempering furnaces.

Rolling Mill Contracts.

Demand for steel works and rolling mill plant remains very small, especially in this country. At the annual meeting of the Brightside Foundry Company, reference was made to the fact that among the rolling mill contracts obtained by that firm during the year was one for a large reversing mill plant which had been shipped to Spain. A contract had recently been secured, in the face of the keenest continental competition, for a universal mill of the very latest design for the hot breaking-down of non-ferrous metals, together with all auxiliary plant. The clay-working machinery department of the firm, although it did not work to full capacity last year, was reasonably well employed. The chairman announced that the company had acquired the manufacturing and selling rights of a patented machine for drying washed slack, coal for pulverising purposes, coke, &c., and a machine for the first-mentioned duty had been installed at a colliery in the district, and had been working for some months with most satisfactory results. The same machine would also extract moisture from brewers' grains, damaged wheat, and, in fact, any material containing excess moisture, and was being steadily developed.

Cutlery and Plate.

Little improvement can be found in the cutlery and plate trades, which are carrying on in a moderate state of activity. While a few firms are doing fairly well, the majority are either making no profit or working at a loss, owing to slow sales and low prices. A better state of things is expected before long, as trade generally revives in the autumn. The Director-General of the India Store Department has issued an inquiry for 23,300 table knives, and also for white metal spoons and forks. There is a steady though not large demand for penknives, and one firm engaged in their production has endeavoured to stimulate trade by introducing an extensive range of new and highly artistic patterns of coverings. The scales are machine-engraved in pleasing designs, and some of the knives have gold, rolled gold, and silver scales. The recent innovation of a table knife with a longer handle and a shorter blade than usual has now been followed by the provision of a steel fork to match.

NORTH OF ENGLAND.

(From our own Correspondent.)

Dullness Continues.

THE state of quietude in nearly all branches of industry in the North of England continues. This is a period of the year when the iron and steel trade shows an improving tendency, but movements in this direction are as yet difficult to discern. Political events, of course, have a bearing upon the position, but manufacturers are hopeful of considerable improvement if the Government's efforts to stabilise the pound are successful. So far, the industrial markets in the North of England have pursued an even course, and if steadiness is maintained for the next week or two it is perhaps as much as can be expected. No increase in trading is anticipated until taxation secrets are disclosed, but hopes prevail that business will become brisker after they are revealed.

Cleveland Iron Trade.

While there has been some slight improvement, both in the volume of home business and also in the exports of pig iron during the past week, the Cleveland pig iron market is still extremely dull, and no perceptible diminution has been effected in the large stocks of pig iron. Many consumers are inclined to the use of Cleveland iron, but the disparity of prices as compared with iron from other sources is said to be too great, and many buyers are restricting purchases in the hope of an early cut in quotations. The makers, however, are still firm in their stand against reductions. No. 1 Cleveland foundry iron is 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

East Coast hematite terms vary considerably. Producers are unwilling to admit that market rates are below the basis of ordinary qualities at 60s. 6d., but consumers claim that they can place orders on lower terms. Hematite is comparatively very cheap, as ordinary qualities are barely 2s. above the quotation for No. 3 Cleveland, whereas the pre-war difference was 8s. to 10s.

Ironmaking Materials.

The foreign ore trade is wholly idle, and the price of best Rubio is unchanged at 14s. 6d., c.i.f. Tees. The coke trade is dull and supplies are abundant at 51s. delivered at the works for good blast-furnace grades.

Manufactured Iron and Steel.

There are no quotable changes in manufactured iron and steel. Departments producing constructional steel have contracts that will keep them busy for many months, but other branches are urgently in need of orders. A slightly better account is given of sections engaged on the manufacture of requisites for shipbuilding, owing to the prospects of a few orders for steamers being released as the result of the intention of steel producers to subsidise shipbuilders using only British steel under the rebate system. A few contracts for railway material have to be completed. There is just a little more business passing in galvanised sheets.

Iron and Steel Imports.

Iron and steel imported to the Tees in August was the largest in volume since January. The figure was 16,749 tons, as against 14,489 tons in July. January's total was 18,442 tons. In every branch there was an increase on the previous month. Since November last 141,112 tons have entered the Tees, which included 23,349 tons of pig iron, but of this total 14,018 tons were imported coastwise. In the 1929–30 period, during the corresponding ten months, 123,079 tons were imported.

The Coal Trade.

The general undertone of the Northern coal market remains very disappointing, and the demand for this month's shipment is confined to one or two brands. The only bright spot is the position of Northumberland large steams, the demand for which, while not excessive, is fully up to the current output, with some orders going a-begging, owing to the individual producers having reached their September quota, and hence unable to take on additional trade. Buyers in these cases, instead of transferring the orders to producers of other local grades, are sounding other markets for equivalent grades. Unfortunately, the increased inquiry for large coal is not accompanied by a similar improvement in the position of steam smalls, which are in greater accumulation than ever, and are a drag on the economic yield from the industry. Best Northumberland steams are sparingly offered, and firmly held at 13s. 6d. to 13s. 9d. The prime Wear steam coal trade, on the other hand, is dull, new business being difficult to attract and the output is heavily curtailed. Best large are offered at 15s., with smalls a little firmer at 12s. With limited outputs of Tyne qualities, prices are fully steady, Tyne prime large being 12s. 9d. and small 9s. No sign of any improvement in demand for Durham gas coal for this month's shipment can be discerned, and the market remains depressed. Idle time continues in many areas, and vacant berths at the shipping centres of Dunston and Tyne Dock are particularly numerous. Best qualities can be readily snapped up at 14s. 6d.,

and the special Wear qualities at 15s. Secondary gas coals are abundant at 13s. 6d., while Durham coking unscreened and small are slow of sale, and weakly held at 13s. 3d. and 12s. 6d. respectively. The pressure for bunker qualities is not so keen as recently, sellers offering best freely at 13s. 6d. to 13s. 9d. and ordinary at 13s. Gas makes are the best feature of the coke section, and sellers of superior qualities indicate a firm 18s. Other classes are 17s. 6d. Foundry cokes have an easier appearance once more, and there are ample supplies of ordinaries at 15s. 6d. to 16s. Higher qualities are 18s. to 25s. Beehive coke is in limited offer at 19s. to 24s., and blast-furnace coke for home use is abundant at 15s. delivered at the works.

SCOTLAND.

(From our own Correspondent.)

Shipyard Development.

IT is understood that work on Barclay, Curle and Co.'s graving dock scheme will commence at an early date. The new dock will have a length of about 620ft., an entrance width of 85ft., and a depth of water on the sill of 28ft. at average high water spring tides. The new dock will be situated parallel with the firm's existing dry basin known as Elderslie Dock. Messrs. Barclay, Curle own the largest ship-repairing establishment on the Clyde, being able to handle 750,000 tons of shipping annually, and the new dock will increase the capacity to round about 1,000,000 tons.

Largest Contract for Coal Conveyors.

At the jubilee celebrations of the firm of Mavor and Coulson, electrical engineers, Glasgow, last week, Mr. Sam Mavor, chairman of the firm, announced that they had received the largest order for conveyors for use underground in coal production that had ever been placed. It is said that the contract is for forty machines, at a total cost of £40,000. Mr. Mavor also said that the firm had more work on its books at present than it ever had before at any one time, and it would be able to provide full-time employment for all its workers throughout the winter.

Steel.

There has been no feature of note in the Scottish steel trade during the past week. The depression in the shipbuilding industry is mainly responsible for the reduction of steel output to about 35 per cent. of the capacity. It is not surprising therefore that recent orders for new ships have caused a measure of satisfaction to steel makers even though the number of these orders is comparatively small. In times such as these it is also worthy of note that several cargo steamers are included in the new contracts. Already inquiries for plates and sections are a shade more numerous. Sheet makers are indifferently engaged, only those engaged in the production of thin sheets being regularly employed. Heavy sheets are not only up against low prices in the export market, but have to face competition from foreign sheet makers. Business in tubes is extremely poor. Prices show no change.

Iron.

Bar iron producers make little progress. Competition from Belgian material is drastic, both at home and abroad, and orders from tube makers, formerly of a substantial nature, have dwindled away, owing to stagnation in the tube industry. Re-rolled steel is poorly specified, and even allowing for the fall in price of foreign billets the price quoted is said to be unremunerative at £6 per ton, home or export.

Pig Iron.

The total production of pig iron in Scotland at present is confined to the output from one furnace. The greater use of scrap in steel making and continued imports of material from abroad and across the Border, have played havoc with the local industry. During the past week another consignment of over 1000 tons arrived from India and one of 500 tons from England. Total exports from the district did not exceed 230 tons.

Scrap.

There is little demand for scrap, and prices remain weak, round about 47s. 6d. for cast iron machinery and 37s. 6d. for heavy steel scrap.

Coal.

Up to the present the wages dispute affecting safety men at the pits has had little real effect on the market, and prices have hardly been touched. The only result has been to facilitate to a certain extent business at home and abroad. Some foreign buyers have placed orders in view of a possible stoppage of work, but the extra business does not amount to a great deal as yet. Business done has been for prompt or early shipment, and while collieries have been disposed to hold out for full current prices, there has been no disinclination to sell. Large coals, as a rule, are plentiful, and the strong feature is still provided by double nuts. Aggregate shipments amounted to 199,066 tons, against 213,493 tons in the preceding week and 256,285 tons in the same week last year.

Safety Men to Stop Work.

The result of the ballot on the wages dispute has resulted in a majority in favour of a stoppage. Intimation will be made by September 14th, but the time for negotiation does not expire until September 30th. The effect of a stoppage would be disastrous to colliery property, and it is confidently anticipated that a settlement will be arranged.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THE steam coal trade pursues its quiet course, and the past week has displayed no new feature of any description. New business is still very scarce and the majority of collieries are short of orders to enable them to work regularly. The weekly volume of shipments varies, but it is only on rare occasions that the trend is in an upward direction. According to the returns of the Great Western Railway Company for the six ports in this district under its control, the total last week was only 384,170 tons, whereas for the preceding week the quantity was 468,290 tons, and for the corresponding period of last year the figure was 529,216 tons. For the whole of this year to the end of last week shipments of coal and coke were down no less than 4,656,820 tons, as compared with the same period of last year. The fact that insufficient supplies of tonnage are being placed at the disposal of collieries is shown by the fact that at the end of last week the number of idle tipping appliances at the various ports amounted to as many as forty-six, and even on Monday, after allowing for the arrival of tonnage over the week-end, the number of idle appliances was still as high as thirty-two, while there were only three steamers waiting to berth, of which two were at Swansea and one at Port Talbot. It was thought that the loading situation would have been better than this on Monday, as quite a fair amount of tonnage was chartered during the latter part of last week, though by no means all of it was for prompt loading. The foreign demand continues to be extremely quiet, and so far as inquiries go there is no outstanding business on the market. It is true that the Swedish State Railways have asked for prices for about 45,000 tons of coals for delivery from October to December, but it is unlikely that much, if any part, of this order will come to South Wales. So far as the French and Belgian schemes for the limitation of coal imports are concerned, there has been no fresh development, except that, in the case of France, the scheme has been modified to the extent that it has been suspended until October 31st, so far as coke is concerned.

Minimum Prices.

Reference was made some time ago to the fact that a move had been made by certain groups of collieries for a re-classification of their coals, and it was well known that the coals concerned were the best qualities. When times are bad, it is invariably the case that buyers are satisfied with lower grades, as being the cheaper, and the consequence has been that the first qualities have suffered. There is at present a difference of 1s. 3d. per ton between the very best large and other grades of Admiralty large coals, and it is obvious that such a margin is bound to operate adversely so far as the best descriptions are concerned. The application of the collieries for a revision went to arbitration and the award was received at the end of last week. From the report current on the market it is gathered that the award finds that the collieries mainly concerned have made out their case. The adjudication was due to come up for consideration at a meeting of the Commercial Committee of the coalowners early this week, and a definite statement on the position is awaited with considerable interest on the market.

LATER.

The Executive Committee of the South Wales Coal Marketing Association decided on Tuesday to revise the minimum prices of best large steam coals. Class A coals are reduced from 20s. to 19s. 6d. f.o.b.; class B from 19s. 9d. to 19s. 4½d.; class C from 19s. 6d. to 19s. 1½d.; class D from 19s. 3d. to 19s.; and class D (2) from 19s. to 18s. 10½d. All other prices remain unchanged, and the alterations that have been made do not apply to the inland market.

Coal Trade Statistics.

At the end of last week a statement was issued by the secretary of the South Wales coalowners regarding the report of the joint accountants of the Coal Trade Conciliation Board for the three months ended July 31st. This reveals a position appreciably worse than that shown by the audit for the three months ended April last. The auditors certify a loss of 0·82d. per ton, compared with a profit of 2·32d. per ton in the previous three months, but, in arriving at these trading results, certain capital and other charges are not admissible for the specific purposes of the audit, and as these excluded charges amount approximately to between 6d. and 9d. per ton, it will be seen that the real deficit suffered by the industry in the three months ended July last was nearly 10d. a ton. There was a slight increase in wages and in costs of production other than wages, and the percentage certified under the formula laid down in the agreement for the purpose of wage regulation was 0·49 on the 1915 standard rates. This compares with 5·81 in the three months ended April last. The minimum percentage payable, however, under the agreement, is 20 per cent. above the 1915 standard rates, and the owners will be called upon to meet the cost of the difference between this minimum and the certified economic percentage of 0·49. The outstanding fact disclosed by the statistics for the three months ended July 31st is that in the extent of its production and in the volume of its trade the South Wales coal-mining industry has receded to the position held by it in 1900, or thirty-one years ago. Giving a comparison with 1913 it is pointed out that the cargo export trade for the three months ended July 31st has fallen from 15,003,581 tons to 9,365,688 tons, a decline of 37 per cent. The number of persons employed in the coalfield last July was 148,918, which compares with 167,407 in the corresponding period of 1930, while in 1913 the number was no less than 233,134. The review proceeds to show that the statistics completely reveal the fallacy of the arguments of the men's leaders that reductions in the hours of labour tend to increase employment.

Freight Rates.

During the past ten days there has been a marked collapse in the outward rates of freight for coal to Mediterranean destinations, and there can be no question that shipowners are feeling extremely anxious, especially as trading conditions have been utterly unprofitable for some time past. Quite a fair amount of tonnage has been chartered for loading from the Black Sea and Danube, and this tonnage has, as a consequence, been seeking a freight for the Mediterranean, but orders have been scarce, and the result was that about the middle of last week owners showed a disposition to pick up whatever business was available at the rates that merchants were offering, and rates weakened perceptibly. Almost all the orders on the market were fixed last week, and as this week tonnage was still seeking employment, rates fell further, until a 5000-tonner was chartered for West Italy at 5s. 6d., and a 6000-tonner for Venice at 6s. 6d., while steamers were fixed for Alexandria at 6s. The rates for the Italian ports are pretty well a low record for post-war business, and, in fact, they are worse than the rates prevailing before the war, for the reason that since then shipowners' expenses have gone up 50 to 60 per cent. Such appalling rates as are now ruling can only mean that more shipowners than ever will be compelled to lay up their steamers.

Miners' Wages.

The South Wales Miners' Federation executive adopted a resolution urging the Miners' Federation of Great Britain to take up the wages question, as the present temporary arrangement expires in July next. It was urged that steps should be taken as early as possible to stabilise wages instead of waiting until the end of July.

Municipal Schemes.

While the Cardiff Finance Committee has decided to recommend to the City Council a three years' respite from new capital expenditure, the Swansea Borough Council has approved two schemes estimated to cost a total of £2,096,624, and has instructed the Town Clerk to apply for sanction to borrow the necessary money. The two schemes are the new super-electricity station, estimated to cost £1,391,630, and the first section of the new main drainage system, the provisionally accepted tender for which totalled £704,994.

Current Business.

Operations in steam coals have been exceptionally quiet, and prices all round have shown no change. Patent fuel and coke remain steady, while pitwood maintains a good tone for prompt supplies.

CONTRACTS.

BEYER, PEACOCK AND CO., Ltd., have received an order from the London, Midland and Scottish Railway for the equipping of thirty "Beyer-Garratt" locomotives with patented self-trimming coal bunkers.

DAVEY, PAXMAN AND CO., Ltd., of Colchester, have recently received from the Bank of England, for which Dr. Oscar Faber is consultant, and Drake and Gorham, Ltd., contractors, an order for four Paxman totally enclosed heavy duty oil engines. Each engine is of eight cylinders, capable of developing 450 B.H.P. at 650 r.p.m., and will be direct coupled to 300-kW D.C. generators. The Great Western Railway Company has also ordered two 45-kW Paxman marine auxiliary sets with generators through the Sunderland Forge and Engineering Company, Ltd.; and the Eagle Oil and Shipping Company, Ltd., has also ordered two Paxman propulsion engines with reverse gears.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

DORMAN, LONG AND CO., Ltd., on September 1st, 1931, opened an office at Royal Insurance Building, Grey-street, Newcastle-on-Tyne.

MR. H. L. ARMSTRONG has been appointed general manager of the British Mannesmann Tube Company, Ltd., in succession to Mr. L. Hall, who has resigned after many years' service.

STOTHERT AND PITT, Ltd., inform us that they have disposed of their interest in "Burn" patent Gears to Burn Silent Gears, Ltd., Caxton House, Westminster, London, S.W. 1, to whom all communications regarding these gears should be addressed in future.

THE SCHLOEMANN AKTIENGESELLSCHAFT, of Dusseldörf, asks us to say that a very large installation for the manufacture of large seamless tubes and seamless receptacles will be open to visitors in its shops—M.F. Ausberg-Nuernberg—at Nuremberg up till September 20th.

BOSCH, Ltd., ask us to announce that on and after Saturday, September 12th, 1931, their London address will be Larden-road, Acton, London, W. 3. Telephone, Shepherds Bush 2080 (four lines); telegrams, "Elecbright, Act, London." The Scottish depôt will remain at 222, Bothwell-street, Glasgow, C. 2. Telephone, Central 3154; telegrams, "Elecbright, Glasgow."

A HALF-CENTENARY.—The fiftieth anniversary of the firm of Mavor and Coulson, Ltd., of Glasgow, was celebrated by a "family party" of some 1400 people on September 4th. It was a most happy meeting, and the speeches were reduced to a minimum, so that there was ample opportunity for general conversation. It was also the occasion for the presentation to Mr. W. A. Coulson of a portrait which had been subscribed for by the employees of the firm, and some pleasant remarks by the Lord Provost of Glasgow, Sir Thomas Kelly. The name of this firm is generally associated in the minds of engineers with the production of coal-cutting machinery, for it is, no doubt, pre-eminent in that direction; but it is sometimes forgotten that the firm, which was founded in 1881 by Henry Mavor, was one of the pioneers in electric lighting, and that it inaugurated the first electricity supply in Glasgow. It was not until 1897 that attention was turned to the electrification of colliery machinery, and at first many difficulties and much opposition had to be overcome. The success of the electric coal cutter was, however, ultimately won by the squirrel-cage motor with cast-on end rings. These cutters are now made so compact that they only require 12in. of head room. Other branches of mining, such as jigging and belt conveyors, owe much to this firm, as does the three-phase system of electric ship propulsion.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	14/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	14/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 0 0	3 0 0
No. 1	3 0 6	3 0 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
,, ,, Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*); 4 0 6 (*b*); 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 10 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6 to 9 0 0	—
Gas Tube Strip	10 12 6	—

STEEL. (*d*)

	(8) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
,, ,, (Land)	10 10 0	10 0 0
Ship Plates, ¼in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.)	10 12 6	9 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
,, ,, (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
,, (Small Round)	6 10 0	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
,, (Lancs. Boiler)	8 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 9 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars	6 7 6 to 7 0 0	—
Billets and Sheet Bars	4 17 6 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	9 0 0 to 9 12 6	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0	—

NON-FERROUS METALS.

SWANSEA—		
Tin-plates, I.C., 20 by 14	t.o.b.	13/- to 13/3
Block Tin (cash)		114 10 0
,, (three months)		117 2 6
Copper (cash)		31 6 3
,, (three months)		32 3 9
Spanish Lead (cash)		10 17 6
,, ,, (three months)		11 0 0
Spelter (cash)		11 1 8
,, (three months)		11 11 3
MANCHESTER—		
Copper, Best Selected Ingots		35 0 0
,, Electrolytic		36 0 0
,, Strong Sheets		62 0 0
,, Tubes (Basis Price), lb.		0 0 10½
Brass Tubes (Basis Price), lb.		0 0 9½
,, Condenser, lb.		0 0 11½
Lead, English		12 7 6
,, Foreign		11 0 0
Spelter		11 7 6
Aluminium (per ton—raw ingot)		£85

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11½ per lb.	
Ferro Tungsten	1/8½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/-
,, ,, 6 p.c. to 8 p.c.	£20 12 6	7/-
,, ,, 8 p.c. to 10 p.c.	£19 17 6	6/6
,, ,, Specially Refined		
,, ,, Max. 2 p.c. carbon	£30 0 0	10/-
,, ,, ,, 1 p.c. carbon	£34 0 0	12/-
,, ,, ,, 0·70 p.c. carbon	£35 15 0	13/-
,, ,, ,, carbon free	9½d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
,, ,, ,,	£11 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£10 10 0 scale 5/- per unit	
,, ,, 75 p.c.	£15 0 0 scale 7/- per unit	
,, Vanadium	12/9 per lb.	
,, Molybdenum	4/2 per lb.	
,, Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	8/- per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/6
,, ,, Ell	14/3
,, ,, Splint	14/- to 15/9
,, ,, Trebles	12/6 to 13/-
,, ,, Doubles	12/- to 12/6
,, ,, Singles	10/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	17/-
,, ,, Trebles	13/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/9 to 12/6
Screened Navigation	17/-
Trebles	13/6 to 14/6
Doubles	12/6 to 12/9
Singles	10/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	10/9 to 11/-
Secondary Steam	10/- to 10/6
Trebles	12/6 to 13/-
Doubles	12/6
Singles	10/-

(8) N.W. COAST— ENGLAND.

	Export.
Steams	20/-
Household	30/- to 51/-
Coke	20/- to 20/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/-
Steam Smalls	7/6 to 8/-
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD—	Inland.	Export.
Best Hand-picked Branch	24/6 to 25/6	—
South Yorkshire Best	23/6 to 24/6	—
Derbyshire Best Bright House	21/- to 22/-	—
Best House Coal	21/6 to 22/6	—
Screened House Coal	19/- to 20/-	—
Best Screened Nuts	18/- to 19/-	—
Small Screened Nuts	16/6 to 17/6	—
Yorkshire Hards	17/- to 18/6	—
Derbyshire Hards	17/- to 18/6	—
Rough Slacks	9/6 to 10/6	—
Nutty Slacks	7/6 to 8/6	—
Smalls	5/6 to 6/6	—
Blast-furnace Coke (Inland)	12/3 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b., 14/- to 15/-		

(9) SOUTH WALES.

CARDIFF—	Export.
Steam Coals:	
Best Smokeless Large	19/6
Second Smokeless Large	18/10½ to 19/4½
Best Dry Large	18/6 to 18/9
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/9 to 20/-
,, ,, Smalls	15/- to 16/-
No. 2 ,, Large	17/- to 17/3
,, ,, Through	15/6 to 16/-
,, ,, Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	19/- to 19/9
Pitwood (ex ship)	27/- to 28/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	40/- to 43/-
Beans	24/9 to 28/3
Peas	21/- to 22/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/-
Steam Coals:	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations

French Engineering Notes.

(From our own Correspondent in Paris.)

Trade Tendencies.

AMONG events arising out of the unsettled state of the steel industry are the shipment of a small consignment of Russian steel from the Black Sea to Antwerp, and a large delivery of German steel at Bordeaux. The Russian experiment is a bold one in view of the fact that bars are quoted as low as £3 4s. f.o.b. Antwerp. Still more disturbing to French and Belgian steel makers is the fear of developments in Great Britain, which, it is affirmed, may restrict imports and enable British makers to realise economies and compete more successfully for foreign trade. Meanwhile, wages on the Continent are being reduced periodically. In Belgium, there has been another 2½ per cent. reduction, and in Luxemburg steel makers have posted notices of a 5 per cent. drop in wages. In France it is felt that the only chance of saving the situation lies in terminating negotiations for the salvage of the Steel Cartel, which are being suspended by the Germans pending the reorganisation of their industry. One effect of the suppression of German reparation material is that a powerful British dredger has recently been delivered to the port of Havre. It has a length of 190ft., and has twin propellers and engines of 1500 horse-power.

Railway Organisation.

The railway companies have decided that nothing but a complete reorganisation of the transport system can place them beyond risk of financial crises, such as that through which they are now passing, and they have settled upon a plan which aims at adapting transport facilities to the changes that have occurred in traffic conditions. In a large country with a comparatively sparse population the motor car is having a decentralising effect, and there is a movement of population away from the railways. The motor car services between Paris and Nice and other distant towns show what may be expected when the network of motor roads over the Continent is completed. The International Bureau of Motor Roads is now meeting at Geneva in order to complete its scheme which provides, so far as France is concerned, for a motor road from Gibraltar through France and Germany into Yugo-Slavia. Another will go from Cherbourg, through Paris, to Belgium and Holland, and in France there will be a road to the Riviera. It is claimed that these motor roads will not compete with the railways, but should rather bring traffic to them, and it is with this object in view that the railway companies are preparing their new scheme. The main lines will be employed for express traffic, and the stations will be at an average distance of 25 kiloms. instead of 5 kiloms, as at present, which means that the number of stations will be reduced from about 8000 to 1600. From each main line station there will radiate local lines, either of railways or road motor vehicles, to "intermediate stations," around which, again, there will radiate collecting depôts. Thus, a considerable area will be covered by the network, and communication between neighbouring main line stations will be effected by these local services. The character of the local lines will depend upon the traffic, and the choice of rail motors or road vehicles will be determined by circumstances; but in all cases the object will be to run the services as far as possible with full loads. On the main lines the passenger trains will not run for distances of less than 150 kiloms. Intermediate main line stations will be served either by rail cars or by road vehicles. Goods will be dispatched to the main line stations, and from thence distributed to the "intermediate" or local stations and depôts for delivery to customers. In the same way, goods will be collected all around the district by the depôts and sent to the main line station, where they will be made up in full wagon loads or dispatched by road, according to circumstances. The idea is to give to the service the greatest possible flexibility with the use of rail motors, oil locomotives and road vehicles, and the station master will decide how to deliver the goods in the quickest and cheapest manner. The fitting in of the railways with the air services is also part of the scheme. An instance of the assimilation of road vehicles by the railway companies is afforded by the new branch line which is to be built between Nantes and Indret, where there is a State arsenal and where the necessity of constructing a line, about 7¼ miles long, has long been urged. The line would, obviously, be unprofitable in the absence of general traffic, and it has, therefore, been decided to build it cheaply and use it economically for goods trains and to transport passengers between Nantes and Indret by road.

Refuse Disposal.

There was recently put into operation at Aix-en-Provence an installation for the disposal of refuse by fermentation, differing in many respects from the Beccari plant at Cannes, but employing the same principle of converting the refuse into manure. Except at Lyons, which is a great industrial centre, the refuse in the South of France is mainly vegetable, and all attempts to incinerate it have had to be abandoned on account of the cost. The installation at Aix consists of a building with sorting plant and having on the roof sixty-three fermentation cells, each with a capacity of 25 cubic metres. The refuse is discharged from the carts into a pit, whence it is taken by an elevator to riddles for the separation of the coarser material, and then through rotating sieves for the removal of dust and ashes. The refuse then falls on to a magnetic separator for the removal of iron objects and is then carried along a band conveyor, when paper and rags are sorted out by hand. There is now nothing left but the vegetable refuse, which is raised to the cells on the roof. A feature of the new installation is the simplifying of the cells by exhausting the gases into a tank containing sulphuretted water, where they form a sulphate of ammonia. The gases are then passed through an ozone chamber. The temperature of fermentation rises to 80 deg. Cent. and the operation is completed in twenty-five days, or six days less than with the Beccari process. With five hands the plant deals with about 4 tons of refuse an hour. At Lyons the incineration works are well advanced, and will be capable of dealing with nearly 500 tons daily. The energy produced will be about 48,000 kW.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

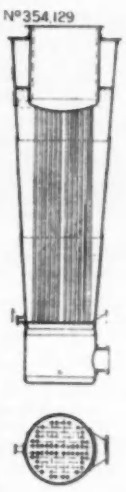
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

354,129. November 6th, 1930.—WASTE HEAT STEAM BOILERS, Humphreys and Glasgow, Ltd., Humglas House, Carlisle-place, Westminster; H. Southworth Cheetham and Gordon Helps.

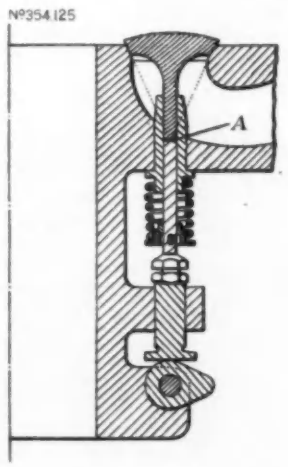
This invention has reference to boilers intended for use in connection with water gas and like apparatus to utilise the waste heat of the gases for the generation of steam. Objects of the invention are to provide a simple construction of boiler of the vertical fire-tube type which will avoid risk of steam becoming locked against the upper tube plate and which will provide ample water surface for the release of steam without priming and will promote a downward circulation of water outside the bank of fire tubes, the upward currents having a free passage through the spaces between the tubes. According to the invention, the shell of the boiler enclosing the water and steam spaces is of upwardly increasing diameter; the bottom of the water space is provided with a tube plate and the steam space has projecting into it through the top a cylindrical gas inlet chamber of considerably less diameter than the boiler shell at that level and the bottom of which is formed by an inclined, downwardly dished or domed tube plate, the two tube plates being preferably of similar diameter and connected by a bank of preferably straight parallel tubes. Below the lower tube plate a gas outlet chamber is formed, preferably by a cylindrical extension of the boiler shell with a lateral gas outlet pipe connection. The normal water level is somewhat above the upper tube plate, the inclined dished or domed shape of which ensures that steam can pass freely from beneath it around its edge into the steam space surrounding the pendant gas inlet chamber, the space between the wall of which and the boiler shell affords adequate surface for release of water steam without priming; the heated gas inlet chamber wall assists in the generation and drying of steam. The conical shell provides a clear downward passage for the cooler water away from the steam generating zone of the tubes, thus inducing systematic circulation and guiding the downward water currents into the bank of tubes ready to re-ascend, and so avoiding the indefinite circulation which may obtain when the shell of the boiler is parallel to the tubes throughout their length.—*August 6th*, 1931.



INTERNAL COMBUSTION ENGINES.

354,125. October 28th, 1930.—VALVE GEAR, L. Renault, 8, Avenue Emile Zola, Billancourt, Seine, France.

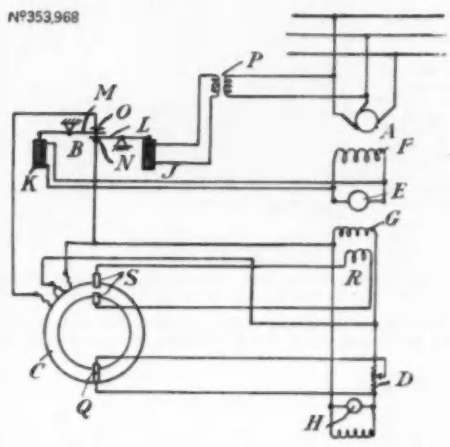
The inventor suggests that by altering the angle of the cone of the valves of internal combustion engines, especially the exhaust valves, they may be made practically noiseless. He suggests an angle of between 60 deg. and 75 deg. and gives an explanation of the way in which he calculates this angle. The idea is that the upper part of the valve and its stem is at a higher temperature than the lower end. The length of a stem which would give, when heated to the higher temperature, an expansion equal to that due to the average temperature, is calculated and is set off from the bottom of the stem. This establishes a point such as A, which is made the apex of the cone of the valve.—*August 6th*, 1931.



DYNAMOS AND MOTORS.

353,966. May 13th, 1930.—ELECTRICAL REGULATORS, the British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2; Henry William Taylor, of "Kilmorie," Bilton, near Rugby, Warwickshire; Charles Stewart, of "Sutherlands," 49, Mansfield-road, Luton, Bedfordshire, and Robert Davies Parry, of "Pen Bryn," Northway, Neaseden.

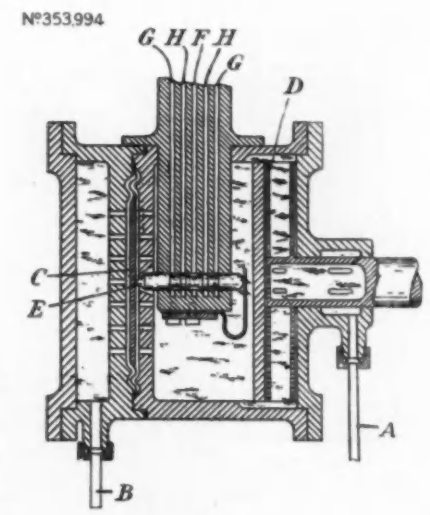
The arrangement shown is mainly of well-known type for controlling the excitation of a generator A in such a manner as to maintain its terminal voltage constant and utilising a vibratory regulator B of the Tirrill type. The regulator operates through a relay C to control the cutting in and out of resistance D in the field circuit of an exciter E, which is connected to energise the field winding F of the generator. In the example shown the field winding G of the exciter is shown as being separately excited by means of a self-excited service exciter H. The regulator B is provided with the usual control windings J and K, which operate to vary the position of pivoted arms L and M respectively and carrying contacts N and O in accordance with the energisation of the coils J and K. The coil J is connected to be energised in accordance with the terminal voltage of the generator A through a transformer P. The coil K is connected to be energised in accordance with the excitation voltage of the generator A, and to this end has its terminals connected across the terminals of the exciter E. The relay C, which is controlled through the contacts N and O of the regulator, has a pair of contacts Q, which are connected to control the cutting in or out of resistance D in the usual manner. With a separately excited exciter E there is a difference in the rate of rise and fall of excitation current when the resistance D is alternately cut out or in of the field circuit of the exciter. In order more nearly to equalise the rate at which the terminal voltage of the exciter responds to a change in excitation, the inventors provide the excitation circuit of the exciter with an additional winding R, inductively related to the field winding G. The terminals of the auxiliary winding may be permanently short-circuited, or connected through a resistance, preferably adjustable. In such a case, the effect of the auxiliary winding is to slow down the rate of response of the terminal voltage of the exciter, but since it is more important to maintain the rate of response of the terminal voltage when the latter is increasing than when it is diminishing, it is preferable to decrease the rate of response only when the voltage is decreasing, while not affecting the rate of response on an increasing voltage. To this end the inventors preferably connect the terminals of the auxiliary winding R across contacts S provided on the relay C and arranged to be closed when the contacts Q are open, and to be open when the contacts Q are closed. Preferably the contacts S are arranged to close somewhat before the contacts Q of the relay open, and for this purpose the bias of the contacts S to the closed position is greater than that of contacts Q to the closed position, or the separation of the contacts S is arranged to be less than that of contacts Q. One advantage of the arrangement is in the reduction of sparking at the contacts Q of the relay C. When the rate of response of the exciter voltage to a decrease in its excitation is quick, as is the case when the auxiliary winding is omitted, considerable sparking has been found to occur at the contacts O. By slowing down the rate of response, however, this sparking is greatly diminished.—*August 6th*, 1931.



MEASURING AND TESTING INSTRUMENTS.

353,994. June 4th, 1930.—SPEED INDICATORS, C. V. Drysdale, 29, Queen's-road, Richmond Hill, Surrey.

This ship's log employs the Pitot tube principle of determining speeds, and incidentally permits a record being transmitted with considerable force to distant stations. The connections from the Pitot tube are shown at A and B. The pressure in B acts directly on the diaphragm C, the pressure in A is transmitted through the impeller of the centrifugal pump D to the opposite side of the diaphragm. The diaphragm actuates a valve E which controls a supply of oil under pressure, supplied at F. G G are exhaust passages and H H connections with the controller of the motor which drives the pump D. The effect is such that the centrifugal force of the pump always exactly counterbalances the differential pressure of the Pitot tube. The speed of the pump is thus a measure of the speed of the ship. As the motor driving the pump may be of any reasonable power, it can be used to drive tachometers and recorders at a distance.—*August 6th*, 1931.



TRAMWAYS AND RAILWAYS.

354,147. December 6th, 1930.—PONY TRUCKS FOR HIGH SPEEDS, F. Kruckenberg and C. Stedefeld, 20, Georgsplatz, Hanover, Germany.

The inventors open their specification by the statement that for high-speed travelling, say, 120 kiloms. to 200 kiloms. per hour, curves should have a radius of not less than from 2000 m. to 2500 m. It is, however, inevitable that some curves must be sharper. A truck which will run satisfactorily round the sharp curves is unsatisfactory on the straight at high speeds. Consequently they attach the axle of the truck wheels to the body of the vehicle by links A A. These links allow sufficient lateral movement to accommodate the curves. The links are provided at B B with spring connections which allow them to extend slightly. In going round a curve the outside wheel tends to travel faster than that inside and extends the spring on its side, so that the axle adjusts itself to the radial direction. Alternative schemes are illustrated, one of which is given in Fig. 2. The action of the linkage is obvious, and it is suggested that the distance apart of the two pivots C C may be adjusted by means of the right and left-hand screw D to suit the immediate condition of the track.—*August 6th*, 1931.

N°354,147

Fig. 1.

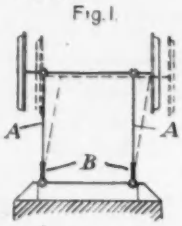
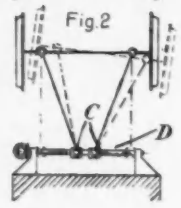


Fig. 2



SHIPS AND BOATS.

354,143. December 1st, 1930.—SELF-LEVELLING DECK HOUSES, T. A. Brown, Bankley Bungalow, Yarm-road, Stockton-on-Tees.

The inventor proposes to mount a ship's deck house in gimbals, with pivots as shown at A and B, so that, acting as a pendulum,

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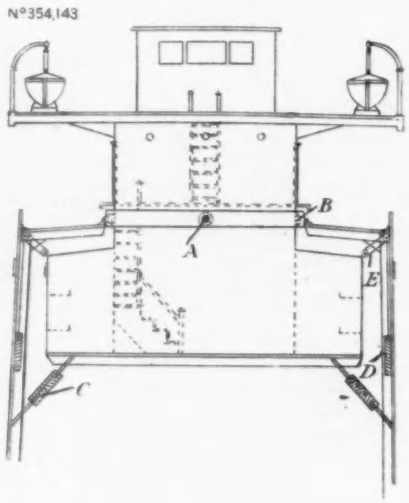

it may remain level as the ship rolls and pitches. He restrains its swinging by springs C and weights D, which are connected by means of the wire ropes and pulleys E.—*August 6th*, 1931.

MISCELLANEOUS.

353,773. September 29th, 1930.—LOCK NUTS, *A. E. White, Quality-court, Chancery-lane, London, W.C. 2.*

In this lock nut a recess A is made in the top. In it two springs B and C are inserted and are riveted over as shown at D. They are held in place by the washer E. The inner spring B is

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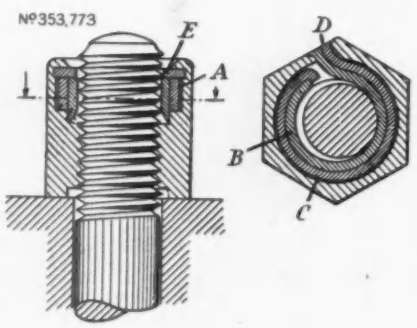

of comparatively soft metal, so that it will not damage the threads of the bolt, while the outer spring is hardened. As the nut is screwed on the springs tend to uncoil and release their grip on the bolt, but they increase their grip when any attempt is made to unscrew the nut.—*July 30th*, 1931.

353,845. January 22nd, 1930.—SOLID RECTIFIERS FOR ALTERNATING ELECTRIC CURRENTS, *Westinghouse Electric and Manufacturing Company, of East Pittsburgh, Pennsylvania, U.S.A.*

This invention relates to rectifiers for alternating electric currents and particularly to metal rectifiers depending upon the unilateral electrical conductivity which exists between a body of copper and a layer of oxide formed on the surface thereof. The principal object of the invention is to provide a method of producing an oxidised copper rectifier which shall be capable of withstanding higher impressed voltages than metal rectifiers constructed on the usual lines. In accordance with one scheme described in the specification, a metallic disc, which is preferably of copper, but which may alternatively comprise an alloy of copper with another metal or metals, such as zinc, is heated to a temperature just below its melting point in contact with an oxidising atmosphere for a predetermined period. In the case of copper the temperature is preferably between 1000 deg. and 1025 deg. Cent., and the heating may be continued for approximately 8 minutes. The unit is then gradually cooled, during a period of several hours' duration, to room temperature. The cooling is preferably at a uniform rate for approximately 4 hours. After the unit has reached room temperature, the oxide may be removed from a portion of the surface and contact made to the underlying metal for the terminal of an electric circuit. Another portion of the oxidised surface may be reduced to the metallic state by contact with a reducing liquid or gas, such as ethyl alcohol, and contact made to the reduced surface for another terminal of the electric circuit. The resulting unit possesses a unilateral electrical conductivity and may be combined in the usual circuit arrangements.—*Application void.*

354,099. September 17th, 1930.—DRYING APPARATUS, R. Schröder, M. Schröder, E. Schröder, S. Levis, R. Levis, and S. Levis, 34–35, Lehderstrasse, Berlin-Weissensee, Germany.

This apparatus is intended for the drying of such material as strips of fibrous electrical insulation impregnated with resin dissolved in a solvent which it is desired to recover. The strip

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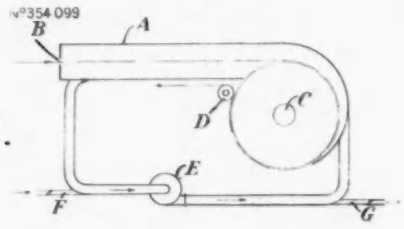

is fed into a chamber A through a slit B, passes over a heated drum C, and is led off again over the roller D. A fan E circulates air through the chamber continuously and a certain proportion of fresh air is constantly added at F, while an equal proportion is removed at G for the recovery of the solvent vapour. It is said that the amount of solvent left in the band after its passage through the apparatus is not worth recovery.—*August 6th*, 1931.

354,128. November 4th, 1930.—DEVICES FOR RECTIFYING THREE-PHASE ALTERNATING CURRENTS, C. H. F. Müller Aktien Gesellschaft, Hammerbrookstrasse 93, Hamburg 15, Germany.

This invention relates to a device adapted to rectify three-phase current and comprising means for obtaining at will two different tensions with the aid of the same device. A delta-connected primary winding A of a three-phase transformer is connected to a three-phase A.C. network. The secondary winding of this transformer consists of phase windings C, D and E. The ends F and G of the windings C and D are connected to one another and the end H of the winding E leads to a switch J. If the latter occupies the position shown, the end H of the winding E is connected to the neutral point of the star-connected secondary winding. The free ends K, L and M of the phase windings are connected to the electrodes of a number of rectifiers N. For each phase winding there are two rectifiers, the cathode of one of them and the anode of the other being connected to the transformer winding. The electrodes of the rectifiers which are not connected to the transformer windings, are connected

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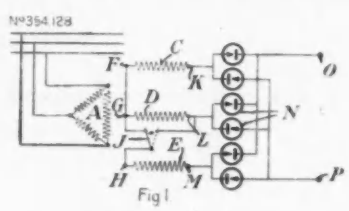


Fig. 1

Fig. 2 Fig. 3

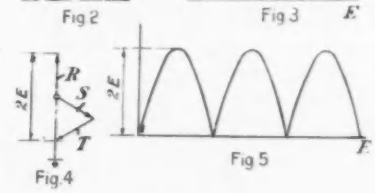


Fig. 4 Fig. 5

to one another and to the terminals O and P of the rectifying device. In this case, the device supplies a D.C. at a tension which, at any instant, is equal to the projection of the rotating vectors—Fig. 2—in which R, S and T are vectors representing the tensions set up in the windings C, D and E. The curve of the rectified voltage has the shape represented in Fig. 3, and this tension shows ripples the peak of which corresponds to a value of $E\sqrt{3}$, whereas the minimum value is equal to 1·5 E, where E represents the maximum value of the phase voltage. The relation of these two values, which only slightly differ from one another, appears from Fig. 2. When the switch J is placed into the position indicated by the dotted line, the end H of the winding E is connected to the end L of the winding D. In this case the vectors R, S and T are as shown in Fig. 4. The curve of the voltage at the terminals O and P as a function of time has the shape represented in Fig. 5. The voltage periodically fluctuates between the value zero and the maximum value 2 E. In both cases the load of the primary winding is the same in every phase, so that the losses on the primary side are as slight as possible.—*August 6th*, 1931.

354,641. November 6th, 1930.—THE MANUFACTURE OF METAL CUTTING AND WORKING TOOLS, Fried. Krupp Aktiengesellschaft, Essen, Germany.

This invention relates to processes of manufacturing metal cutting and working tools and aims at considerably enlarging the sphere of use of metal alloys built up on the basis of carbides of metals of high melting point of the tungsten group. The invention is particularly applicable to the manufacture of such tools as rock drills, coal cutters, twist drills, and so forth, and lathe tools. The invention consists in melting, in a layer of any desired thickness, powdered metal carbides of high melting point of the tungsten group on to a foundation metal, preferably by means of a melting flame, the carbides containing, if required, an addition of a metal of lower melting point, such as cobalt, nickel or iron. The process may, for example, be carried into effect in the following way:—The metal carbide which is to be welded on to the foundation metal is finely powdered and mixed with a flux, such as calcium fluoride. The foundation metal is heated to a red heat and the mixture is applied to its surface in a layer of about 3 mm. Next beginning from one edge of the applied mixture, the foundation metal is melted on its surface by means of a neutral flame which must have a temperature of at least 3000 deg. Cent., and the metal carbide is continuously melted by the burner into the molten bath thus formed. In this operation the lower layers of the carbide mass may form an alloy with the liquefied surface of the foundation metal piece, but by far the greater part of the carbide mass after this melting operation forms a homogeneous layer of metal carbides which is completely welded together with the lower alloyed layer. In order to give the metal carbides as little time as possible for decomposition and alloying with the foundation metal beneath them, the carbide mass must be melted down as quickly as possible by a flame of the highest possible temperature. The so-called metallic hydrogen flame, which has a temperature of 3200 deg. to 3500 deg. Cent., and produces an entirely neutral atmosphere, has given particularly satisfactory results in carrying out the process, but any other carbon or metal arc can be used provided the necessary precautions are taken. The flux is added in order to protect the surface of the foundation metal piece from oxidation, because the foundation metal, on account of its lower melting point, melts somewhat earlier than the metal carbides. This protection results in the metal carbides being homogeneously united with the foundation metal. Particularly favourable welding conditions are obtained by nitriding the metal carbides before welding them on to the ground metal. This nitriding is preferably effected in the manner usual in the nitriding of iron and steel alloys, the metal carbides being subjected at an elevated temperature such as about 500 deg. Cent. to the action of a material yielding nitrogen, for instance, to the action of ammonia, for a long time, such as about 100 hours. In this manner some nitrides are formed which, without reducing the cutting hardness of the material, considerably lower its melting point and viscosity so that a better welding melt is obtained. Furthermore, it has been proved advantageous to employ, as the metal carbide powder to be welded on to the foundation metal, carbides which have been previously sintered and disintegrated again. By this means the oxidation of a portion of the carbide powder during welding is avoided. Finally, it is within the scope of the invention to place sintered metal carbide pieces like islands in the liquefied surface of the foundation metal and to fill with the molten carbide only the spaces existing between these pieces.—*August 13th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY

INSTITUTE OF MARINE ENGINEERS.—At the Shipping, Engineering and Machinery Exhibition, Olympia, W. "Marine Engineering as a Marketing Proposition," by Mr. A. C. Hardy, 3 p.m.; "The History of Marine Refrigeration," by Mr. A. R. T. Woods. 6 p.m.

TO-DAY AND SATURDAY, SEPTEMBER 12TH.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—Congress at Zürich.

"MODEL ENGINEER" EXHIBITION.—Royal Horticultural Hall, Westminster, S.W. 1.

TO-DAY TO SATURDAY, SEPTEMBER 26TH.

SHIPPING, ENGINEERING AND MACHINERY EXHIBITION.—Olympia, W. Daily, 11 a.m. to 9 p.m.

SATURDAY TO WEDNESDAY, SEPTEMBER 12TH TO 16TH.

INTERNATIONAL FOUNDRY CONGRESS.—Milan.

SATURDAY TO SUNDAY, SEPTEMBER 12TH TO 27TH.

INTERNATIONAL FOUNDRY EXHIBITION.—Milan.

SUNDAY TO FRIDAY, SEPTEMBER 13TH TO 18TH.

INSTITUTE OF METALS.—Autumn meeting at Zürich. For programme, see page 21.

TUESDAY, SEPTEMBER 15TH.

OLD CENTRALIANS.—Devereux Restaurant, Devereux-court, Strand, W.C. 2. Luncheon. 1 p.m.

FRIDAY, SEPTEMBER 18TH.

FARADAY SOCIETY.—In the Rooms of the Chemical Society, W. 1. "The Passivity of Metals," by Professor W. J. Müller, of Vienna. 5.30 p.m.

FRIDAY TO SUNDAY, SEPTEMBER 18TH TO 20TH.

NATIONAL SMOKE ABATEMENT SOCIETY.—Annual Conference at Liverpool. For programme, see page 220.

FRIDAY TO MONDAY, SEPTEMBER 18TH TO 21ST.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX.—At Lady Margaret Hall, Oxford. Eighth annual conference. Friday evening, presidential address, by Professor A. M. Carr Saunders. For programme see page 265.

WEDNESDAY, SEPTEMBER 23RD.

INSTITUTE OF FUEL.—In the Rooms of the Chemical Society, Burlington House, Piccadilly, W. 1. Discussion, "The Reactivity of Coke: A Report to the Blast Furnace Committee, Iron and Steel Industrial Research Council," by Mr. J. C. King and Mr. J. H. Jones. 6 p.m.

WEDNESDAY TO FRIDAY, SEPTEMBER 23RD TO 25TH.

INSTITUTION OF MINING ENGINEERS.—Manchester. Postponed summer general meeting.

FRIDAY, SEPTEMBER 25TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Grosvenor House, Park-lane, W. Ball. 9 p.m. to 2 a.m.

TUESDAY TO FRIDAY, SEPTEMBER 29TH TO OCTOBER 2ND.

IRON AND STEEL INSTITUTE.—Autumn Meeting at Swansea. For programme see pages 105 and 255.

WEDNESDAY, OCTOBER 21ST.

INSTITUTE OF FUEL.—At the Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner and dance. 6.45 for 7.15 p.m.

OLYMPIA EXHIBITION—ELECTRICAL MACHINERY

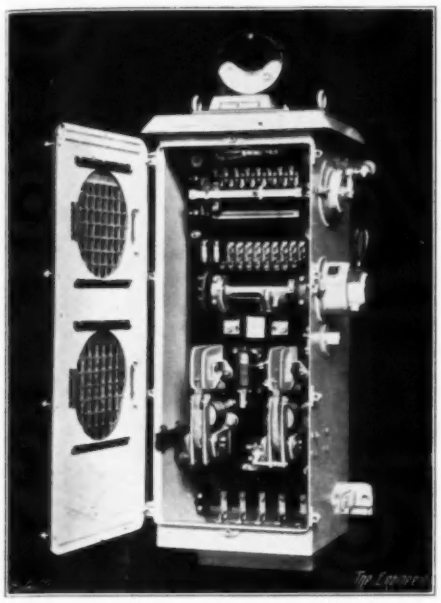


FIG. I.—DRUM-TYPE CONTROL PANEL—BROOKHIRST

FIG. II.—COMBINED STARTER AND SPEED REGULATOR—BROOKHIRST

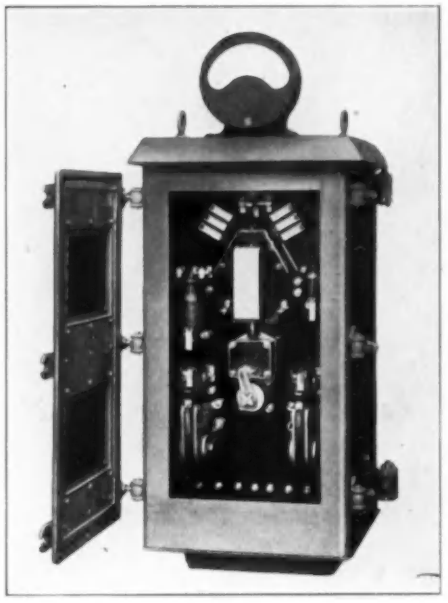


FIG. III.—AUTOMATIC CONTROL PANEL—BROOKHIRST

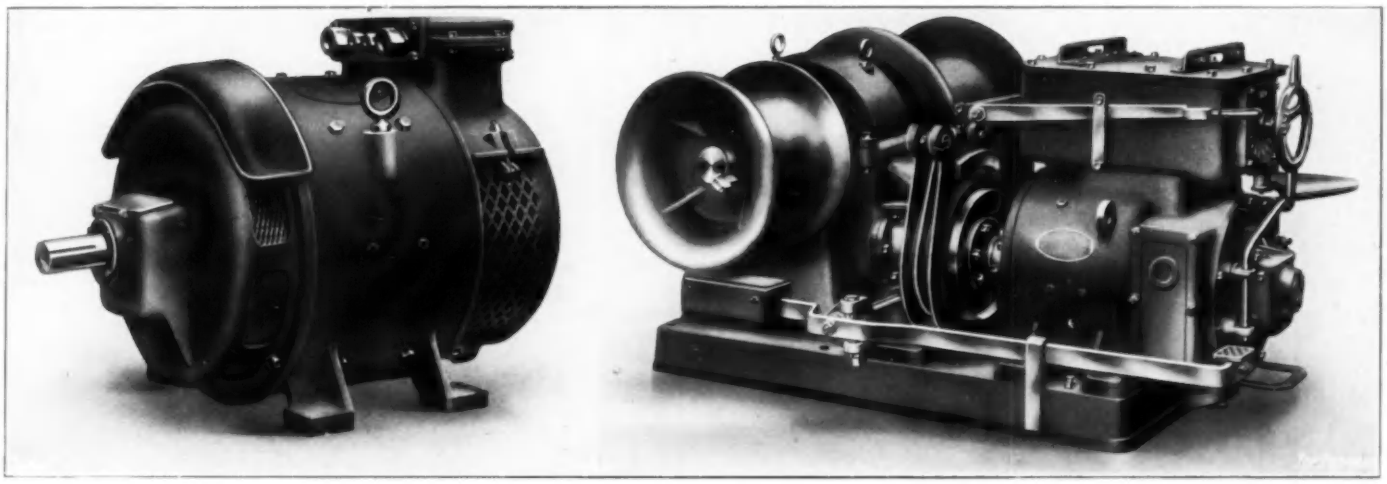


FIG. IV.—MARINE-TYPE MOTOR SUNDERLAND

FIG. V.—3-TON ELECTRIC CARGO WINCH—SUNDERLAND

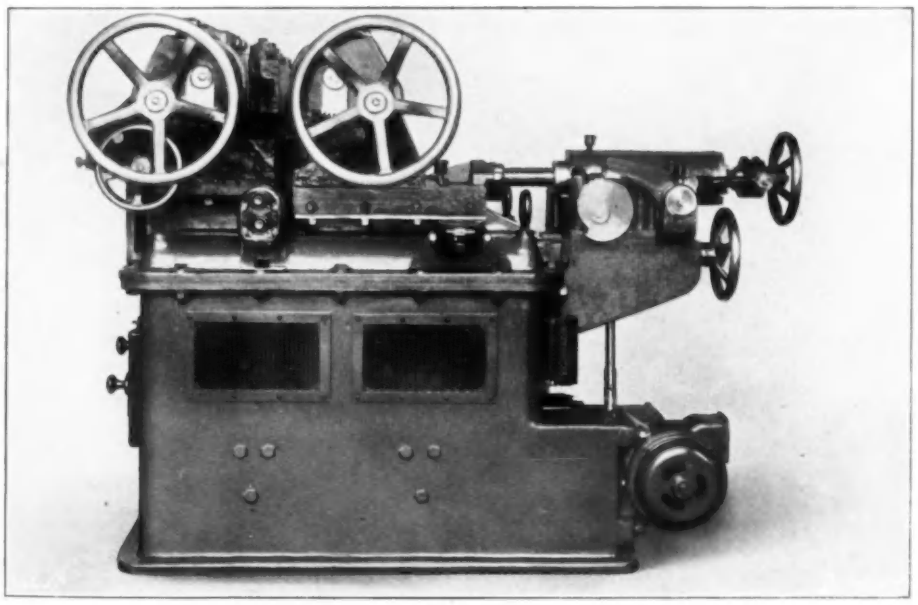


FIG. VI.—BUTT WELDER—BRITISH INSULATED CABLES

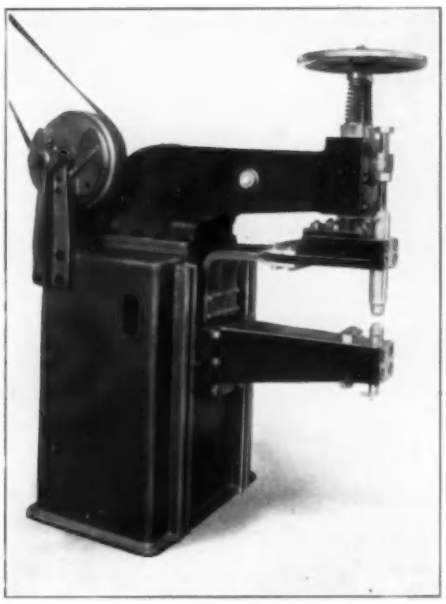


FIG. VII.—AUTOMATIC SPOT WELDER—B.I.C.

OLYMPIA EXHIBITION—OIL ENGINES

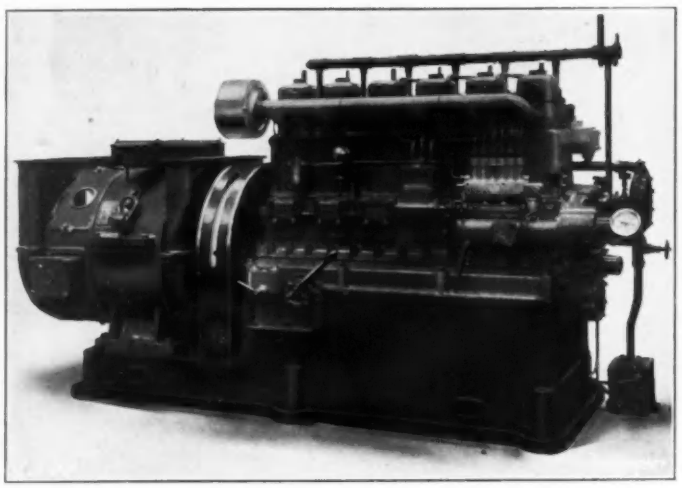


FIG. VIII.—180 B.H.P. AIRLESS INJECTION OIL ENGINE—McLAREN

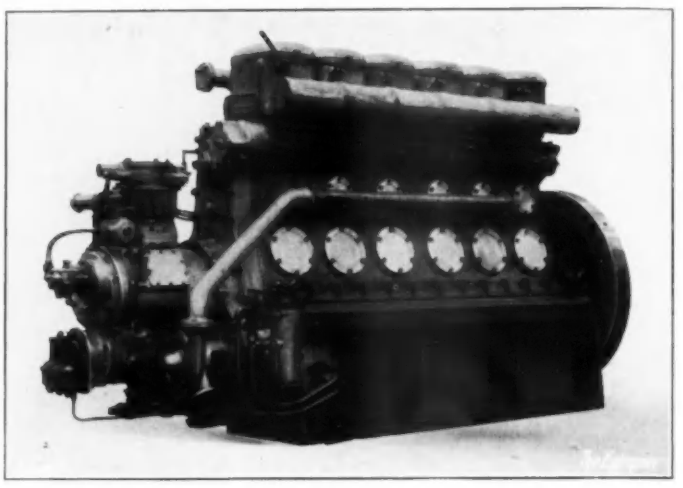


FIG. IX.—360 B.H.P. 6-CYLINDER HIGH SPEED OIL ENGINE—BEARDMORE

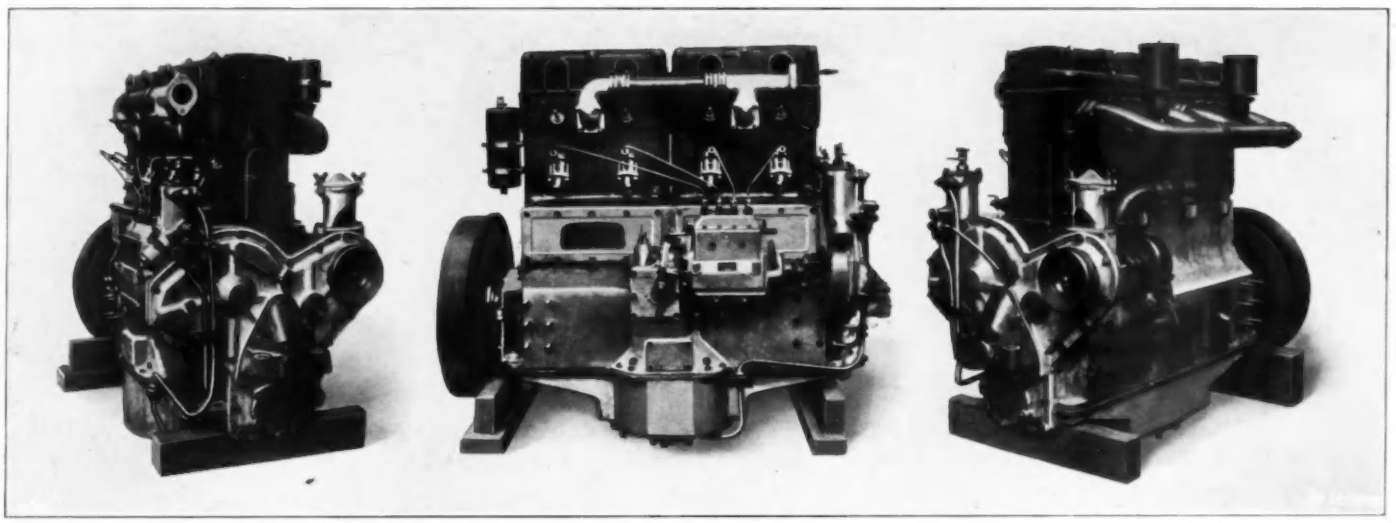


FIG. X.—50 B.H.P. HIGH SPEED MARINE OIL ENGINE—DORMAN

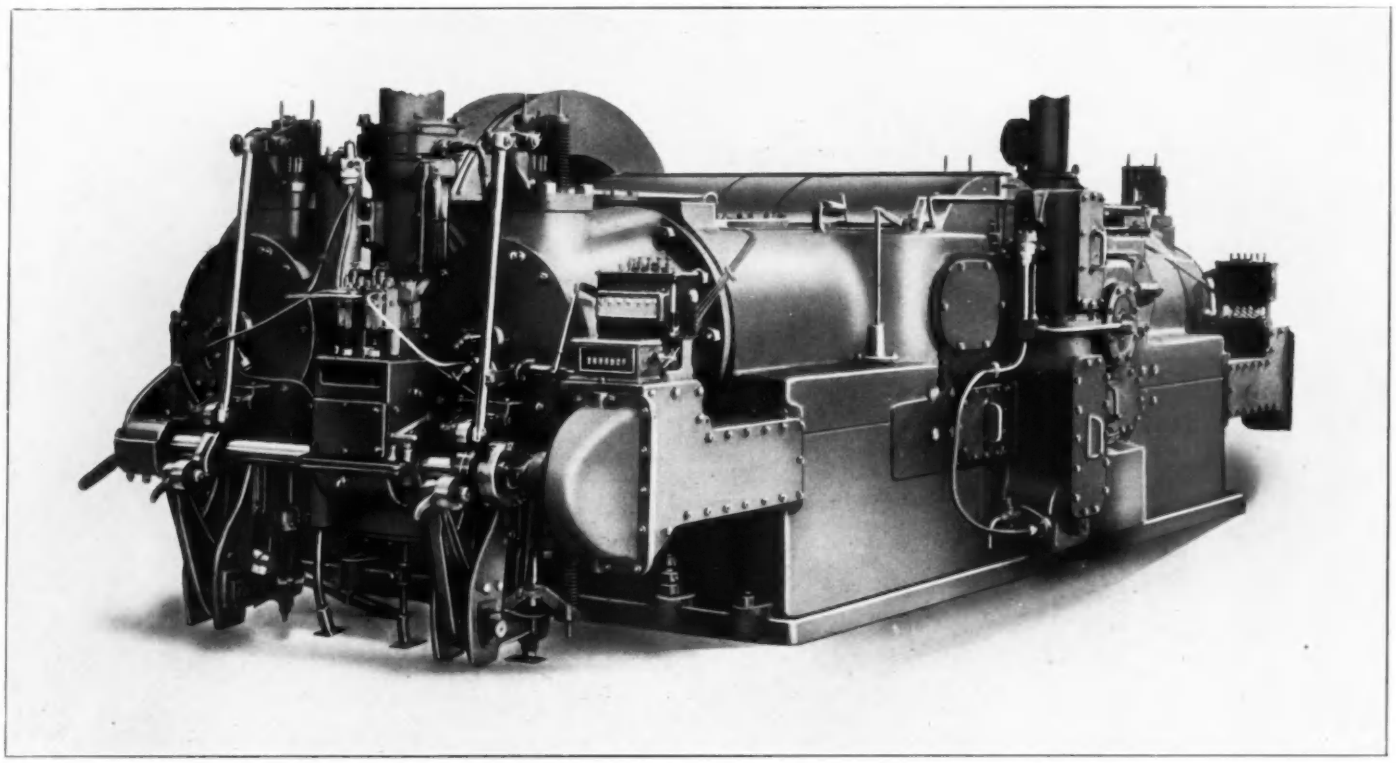


FIG. XI.—310 B.H.P. VIS-À-VIS OIL ENGINE—CROSSLEY

UNIV. OF MICH.

OLYMPIA EXHIBITION—MACHINE TOOLS

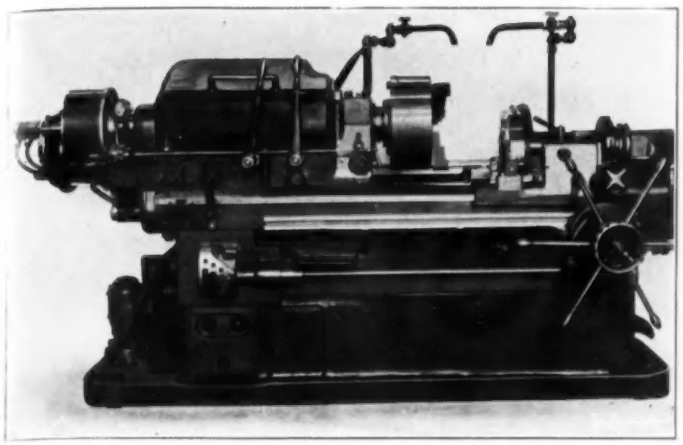


FIG. XII.—Pittler Turret Lathe—United Machine Tool

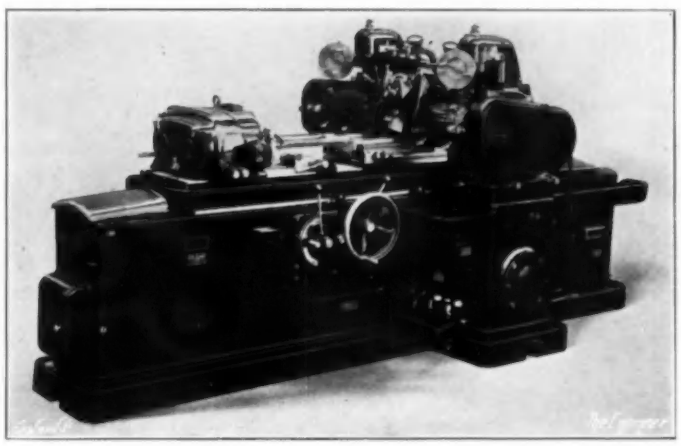
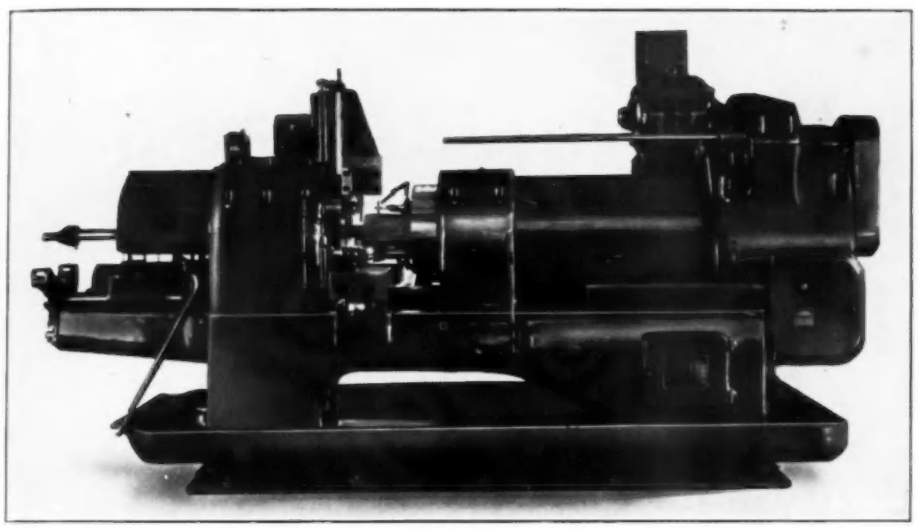
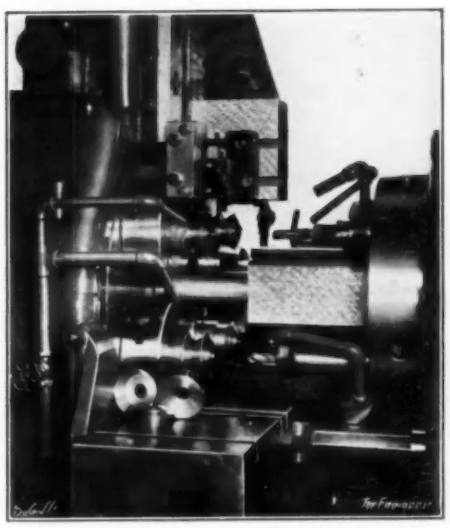
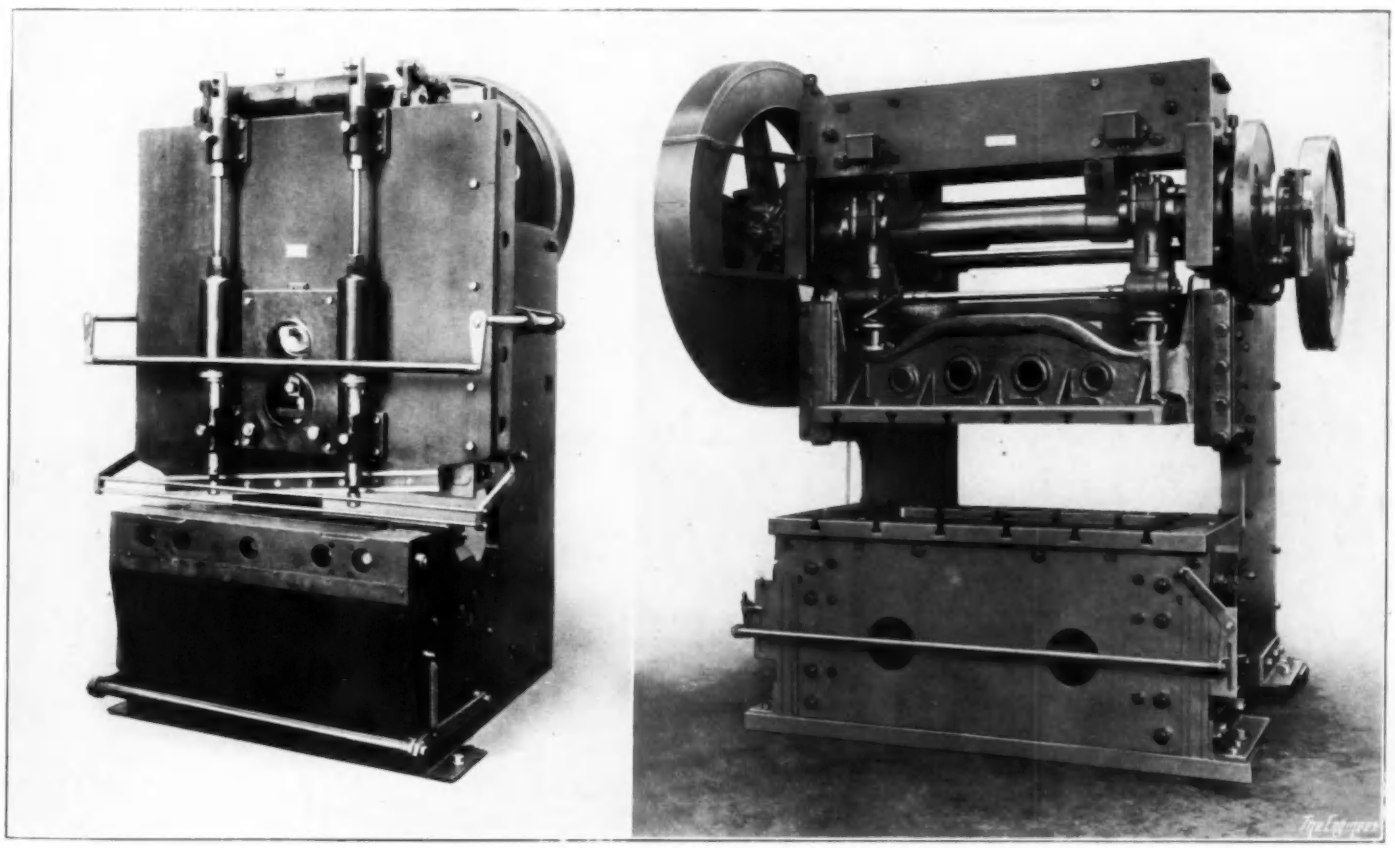


FIG. XIII.—Werner Duplex Automatic Spline Shaft Grinding Machine—Jones





FIGS. XIV. AND XV.—Cleveland Automatic Multi-Spindle Bar Machine—Selson



FIGS. XVI. AND XVII.—Shears and 150 Ton Press—Pels

OLYMPIA EXHIBITION—PUMPS AND COMPRESSORS

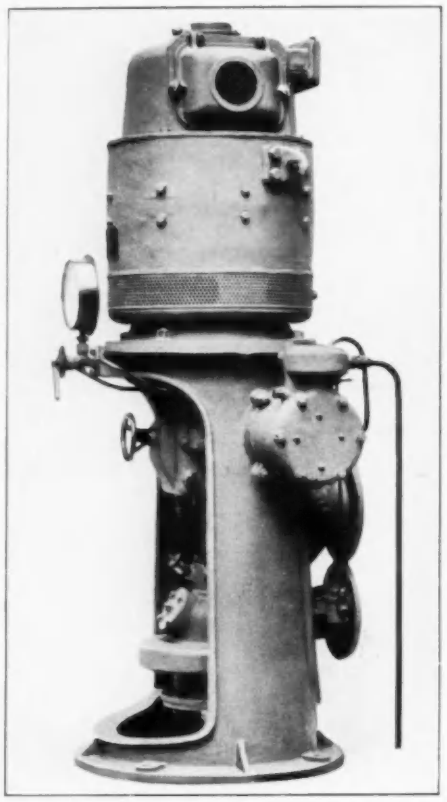


FIG. XVIII.—5IN. MARINE PUMP—PULSOMETER

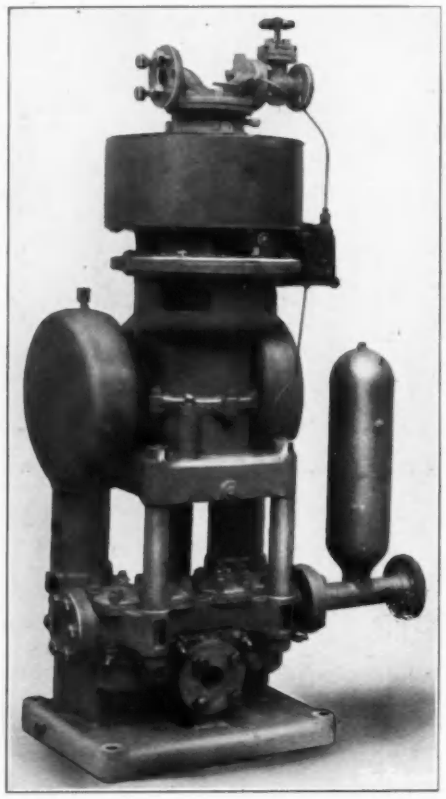


FIG. XIX.—"VERTEX" STEAM DRIVEN RECIPROCATING PUMP—MUMFORD

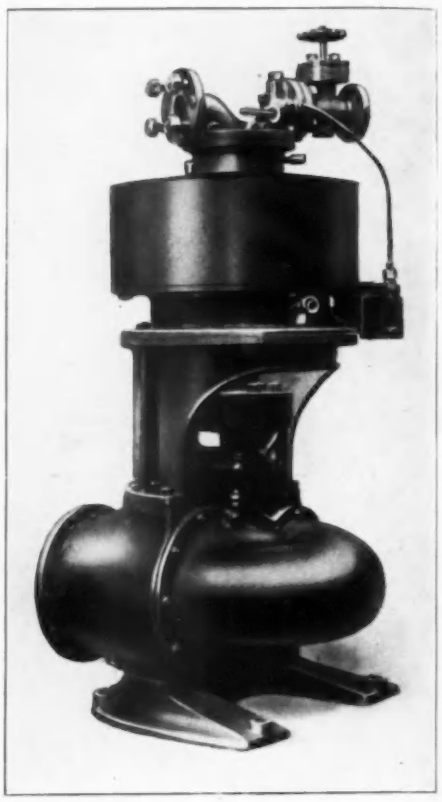


FIG. XX.—10IN. STEAM DRIVEN CENTRIFUGAL PUMP—MUMFORD

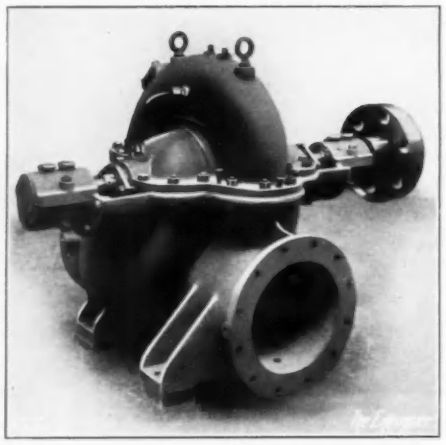


FIG. XXI.—HORIZONTAL SPLIT-CASING CENTRIFUGAL PUMP—MIRRLEES

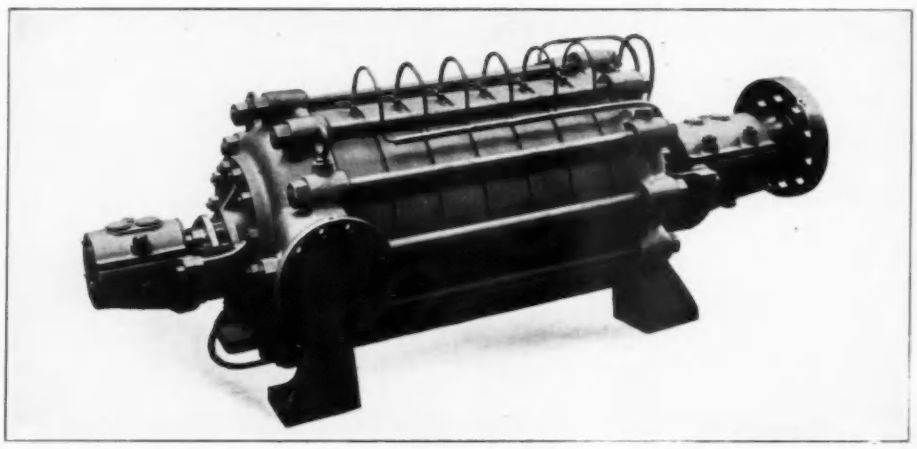


FIG. XXII.—7-STAGE BOILER FEED PUMP—MIRRLEES

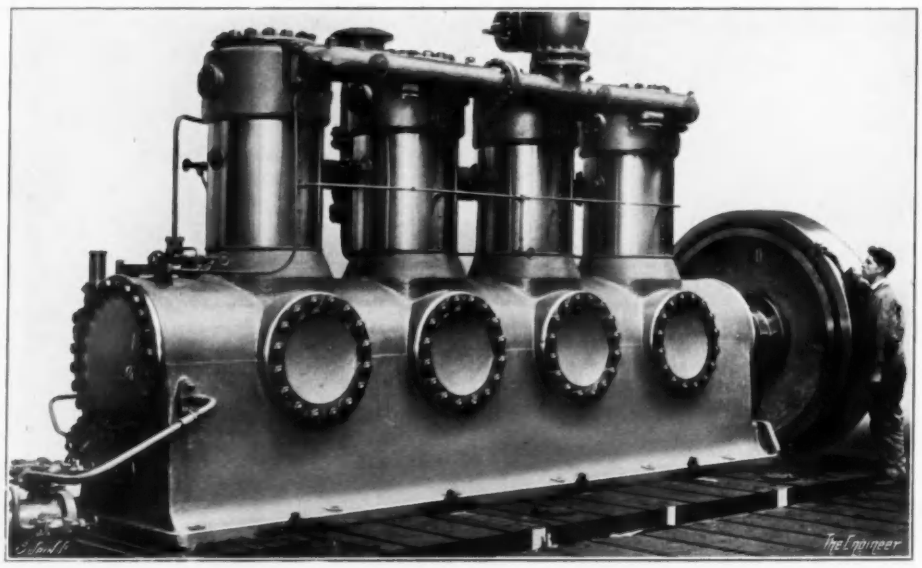


FIG. XXIII.—250 R.P.M. 4-CYLINDER AMMONIA COMPRESSOR—HALL

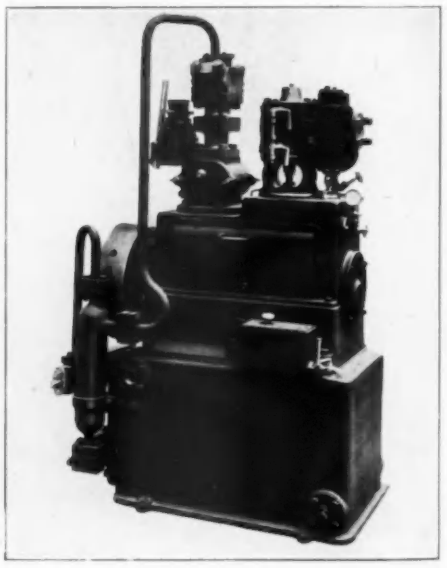


FIG. XXIV.—STEAM DRIVEN CO_2 COMPRESSOR—STERNE